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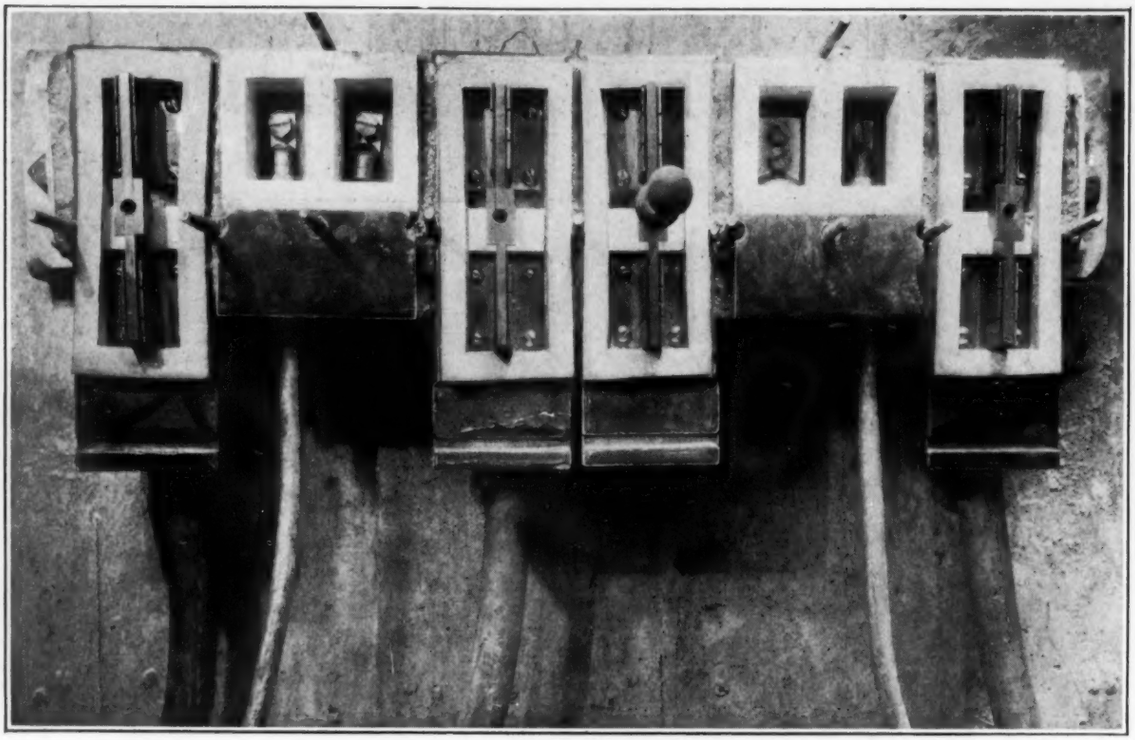

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Electrical World

Published by McGraw-Hill Company, Inc.
W. H. ONKEN, JR.
Editor

VOLUME 86 — *New York, Saturday, July 11, 1925* — NUMBER 2

Two Million New Customers Added

MORE than two million new customers were added to the light and power companies during 1924. This breaks all previous records and parallels the record financing of the same year. Yet the records for the first half of 1925 show evidence that a new record will be again established this year and that the industry will continue to expand at an ever-increasing rate.

On January 1, 1925, there were 16,555,714 customers in this country. In 1924 there were added 2,178,283 new customers to the systems, divided into 1,782,539 domestic lighting, 327,636 commercial lighting and 68,108 industrial power customers. The domestic customer offers the greatest possibilities for economical development today. The field is only scratched in domestic lighting and appliance sales and yet yields splendid returns. Domestic customers give a type and kind of load nearly all systems welcome and yields a revenue where most needed—at the very expensive distribution end of the system.

Those knowing even the present possibilities of the use of electricity in American life and those who understand the statistics of the industry place little faith in pessimistic predictions of load saturation. The demand for electricity increases year after year and new ways of using energy develop equally rapidly. It takes no seer to vision record-breaking developments in the years to come.

Municipal Ownership Checked on Pacific Coast

TWO MILLION DOLLARS a year is a lot of money to pay for the output of a hydro-electric station; especially when the energy has to be transmitted a long distance and, what is more to the point, a market found for it. Yet that is what W. E. Creed of the Pacific Gas & Electric Company bid for the output of the 70,000-kw. station of the city of San Francisco at Moccasin Creek. Of course, some of the city supervisors held out for more; but Mr. Creed packed up and sailed for Europe and the Mayor of San Francisco soon brought his recalcitrant supervisors to reason. The chief beneficiaries of the contract, if it goes through, will be the citizens of San Francisco itself.

For the city to have attempted to distribute the energy of 420,000,000 kw.-hr. locally would have meant the expenditure of many millions for transmission and distribution circuits, not to mention the cost of developing a load in competition with existing public utilities. It would also have necessitated the erection of a huge steam station costing many millions more, if the service were to match that of the existing utilities in quality and continuity. In taking a white elephant off the hands of the city, Mr. Creed has rendered a great public service to his fellow citizens did they but know it; but appreciation is hardly likely except by the informed who have some comprehension of what a task Mr. Creed has accepted for his organization. To them it means hustle. It is no easy task to dispose of 420,000,000 kw.-hr. additional energy yearly in a market pretty well sold; but they are equal to it.

The job is worth doing, however; and in thus checking the spread of municipal ownership on the Pacific Coast, Mr. Creed deserves the thanks of his fellow executives in the electric light and power industry. The problem was difficult; but was ably handled with credit to the Pacific Gas & Electric Company and to the industry of which it is a part.

Electricity Makes Good in Earthquakes

THE Santa Barbara earthquake resulted in very small damage to the Southern California Edison system. The city was supplied largely by outdoor equipment which suffered little, if any, damage, and only an old substation building failed under the shocks. Lighting in the business districts was available the day of the shock and an emergency electrical supply was furnished to hospitals and other buildings. Only fears of short circuits prevented the continuous use of electricity during and after the shocks.

Outdoor substations and outdoor equipments proved immune to earthquakes and the people of Santa Barbara were granted the boon of electricity when gas and water services failed. Similar reports occur from Montana where several shocks resulted only in the felling of three poles on the Montana Power Company system. Reliable electric service under earthquake conditions sets a high standard of accomplishment and requires good engineering construction. The electrical industry can well feel proud of its service record.

Research on Insulation Is Extending

ELECTRICAL engineers are apt to congratulate themselves upon the high degree of perfection reached in electrical apparatus. Not only are efficiencies usually exceptionally high as compared with all other types of mechanical machinery, but electrical apparatus may also be designed for particular purposes with extremely close realization of the desired performance. There is, however, one feature of electrical equipment for which these things cannot be said —namely, the insulation. The performance of nearly all types of electrical insulation may be predicted only within very wide limits. This means that liberal factors of safety must be allowed, which, of course, results in greater space allowance and higher cost. Although the space occupied by insulation in most machines is usually relatively small, it is nevertheless a fact that increase in the thickness of insulation, in a machine slot, for example, has a considerable bearing upon the diameter of the armature and so upon the size of the machine. Further, the labor costs in many types of built-up or fabricated insulation are not inconsiderable, as for example, in the case of built-up mica insulation.

Considerations such as the foregoing keep prominently before designing and research engineers the importance of a better understanding and control of the properties of insulating materials. In the last few years it has become quite clear that the old-fashioned method of judging insulation by its dielectric puncture strength is quite insufficient for determining the performance of insulation. The stages preliminary to breakdown have been studied much more closely, and it is now well recognized that the dielectric losses, in their relation to temperature rise, and as dependent upon the heat dissipating characteristics of the surroundings, are in all probability the most important factors in the life of the insulation. Moreover, it is now well established that the phenomenon of dielectric absorption is the cause of the greater proportion of the total dielectric loss in most types of insulation. Increasing attention, therefore, is being given to the study of this interesting property of dielectrics.

The report of the committee on research, A.I.E.E., presented at Saratoga, indicates a general feeling that best progress in the performance and control of fibrous insulation will come through further knowledge and control of dielectric absorption. A very practical effort in this direction is indicated in the paper by Ralph E. Marbury at the A.I.E.E. convention, describing an apparatus for the quick determination of dielectric absorption by a rotating contact point-to-point method. The method was criticised as not giving true results owing to the very fact that a complete absorption curve requires a relatively long period of time for its observance, and that the phenomenon of residual charge will cause an error in the indications of any short cycle device such as that of Mr. Marbury. On the other hand, it seems not improbable that further study and modification of the instrument will develop its limitations and lead to improvements, so that its indications may be relied on in a relative way as between different materials, and so be a great help in improving processes of manufacture.

Good Lighting and the Reduction of Waste in Industry

A HARD-PRESSED factory or other business has oftentimes been made prosperous by the mere reduction of waste, but effort on this line has not been generally made by individuals or by the nation as a whole. Our standard of living and of working has steadily increased. Most of us accept as commonplace what would have been rare luxuries a score of years ago, and our every-day expenditures would have been beyond the comprehension of our frugal Colonial predecessors. Still, we wonder at the high cost of living. Why not counteract this increasing cost to some extent by eliminating waste? What some far-sighted men have done in their own business Secretary Hoover of the Department of Commerce has been advocating in general through the Division of Simplified Practice, with which many are familiar. In a recent publication this division says that in 1921 in six typical industries —building trades, men's clothing, footwear, printing, metal trades and textile—ten billion dollars could have been saved through standardization and simplification alone. This would have paid all the taxes, purchased all the automobiles sold and gasoline to operate them and built all homes erected in this country in 1922.

These are astonishing figures—but what would adequate and proper lighting do? A conservative estimate of the increase in production which would result from substituting good lighting for bad in our factories and offices runs into the billions annually. The decrease in spoilage would be a ten-place figure as would be the saving through avoidance of the accidents caused by poor lighting. The gain from lessened impairment of vision and health and from increased morale are less tangible, but surely they, too, amount to a great figure. The elimination of waste is a worthy goal for any individual, organization or government agency, but why not add such a valuable ally as good lighting and increase the offensive strength? It can do much in making it possible to maintain American standards of living. In addition it will conserve eyesight, life and health. Good lighting for workplaces and for traffic should be easy to sell because it pays large dividends, not only in dollars, but in conservation of human beings.

Tomorrow's Range Users Must Be Made Today

THOUSANDS of electric ranges have been sold in years past and thousands more will be sold during 1925, and yet the point of saturation is as far away as it was five years ago. New homes are being built and new customers added to the lines of the power companies, but the number of electric ranges is not keeping pace and a tremendous potential load still exists. The two chief deterrents are the unwillingness of many utility executives to accept the range load at rates necessary to obtain it and the unwillingness of the public to accept the electric range as a substitute for present cooking equipment.

The great diversity factor of the electric range load is known, and the unwillingness of utilities to encourage this load would in large part disappear if they could be promised a large ratio of range customers to lighting customers; but electric range development under the present program of the industry will be slow in reaching the point where a large percentage of lighting customers will be range users. There is therefore still apparent a great need for selling the idea of electric cookery to the managers of the nation's households. Users of electric ranges are enthusiastic "boosters," and their recommendations to neighbors and friends constitute the chief and frequently the only aid in the present development of this business. Despite their voluntary advocacy, however, a fundamental lack of appreciation of the inherent value and possibilities of electric cookery exists.

The success of the "better home-lighting" contest emphasized the principle that the most productive soil in which to plant the seed of knowledge of things electrical is the mind of the adolescent. In the case of home cooking not only are its technique and principles being taught in the grammar schools but also the handling of the cooking equipment itself. Here is a starting point. To take full advantage of it two things must be provided—proper instruction and proper equipment. To insure complete and enthusiastic instruction the schools in which teachers are trained should be properly equipped with electric cooking apparatus. Such specialized training as is necessary can be supplied by the co-operation of the electric utilities and range manufacturers of each community. The proper equipment may be introduced most quickly through co-operative agreements between electric range manufac-

turers, school authorities and central-station companies. Concessions in price seem highly justifiable in the case of public school installations where they would be unwise for private or commercial institutions. School boards cannot be expected to pay more for electric cooking equipment than they must pay for fuel-fired equipment. They cannot afford it, nor should they spend more money for equipment little used by the public than for equipment generally used. Once the electric range is installed in the schools, the thousands of children who will use it will learn to prefer it. Here is an opportunity for "casting bread upon the waters." Some far-seeing manufacturer can make his product as familiar and as popular in the minds of the kitchen managers of the next five years as other articles of domestic utility have become.

The Electrostatic Wattmeter

RESEARCH in the field of high-voltage insulation, particularly that of the composite or built-up type, for high-voltage machinery, continues to focus attention on the problem of the measurement of very low values of power at low values of power factor. Improvements in the quality of magnetic iron and its use at higher frequencies are also lowering power factors and losses, so that the methods heretofore in use in measuring these losses also require modification. Thus we find at quite frequent intervals discussions of the several available methods for the measuring of these small losses, as, for example, the various bridge methods, the electrodynometer, and the quadrant electrometer. The last-named instrument, which is coming to be known as the electrostatic wattmeter, has received special attention of late. The behavior of this instrument in practice is beautifully simple and lends itself to a number of different circuit combinations arising in experimental investigation. Unfortunately, however, it is subject to errors which have never been completely understood and for the correction of which extended studies and calibrations are usually necessary for each new instrument. These errors arise in the relatively large number of constants of the instrument due to its three elements, and they are also due to the fact that some of these constants are constant in name only, taking different values when the instrument deflects.

A noteworthy contribution to the theory of this instrument was presented to the recent convention of the A. I. E. E. by Dr. W. B. Kouwenhoven. Starting from the fundamental principles of the instrument, a succession of complete equations are derived, each containing all the constants. The relative importance and values of the constants are discussed, and it is shown how for most instruments only two of the constants remain —the values of these being given—and so the calibration of the instrument may be obtained with the use of low values of continuous potential. It would appear that the paper constitutes a substantial step in advance in facilitating the use of this important instrument.

It should be remembered, however, that perfection of the instrument itself does not remove all the difficulties associated with the measurement of the dielectric losses of high-voltage insulation. The question of insulation for the instrument itself is an important one. In the case of the electrostatic wattmeter the needle must carry full-voltage or a fraction thereof. In the case of full voltage, if the circuit is above 5 kv. or 10 kv., this means an instrument of special design and large size. If a fraction of the total voltage is used for the needle circuit, a fractional tap on the transformer winding is required or some other external form of potential divider. Either of these arrangements usually introduces a phase difference between the fractional voltage and the circuit voltage, which may cause a serious error in the readings of the instrument.

Good Public Relations Built on Good Employee Relations

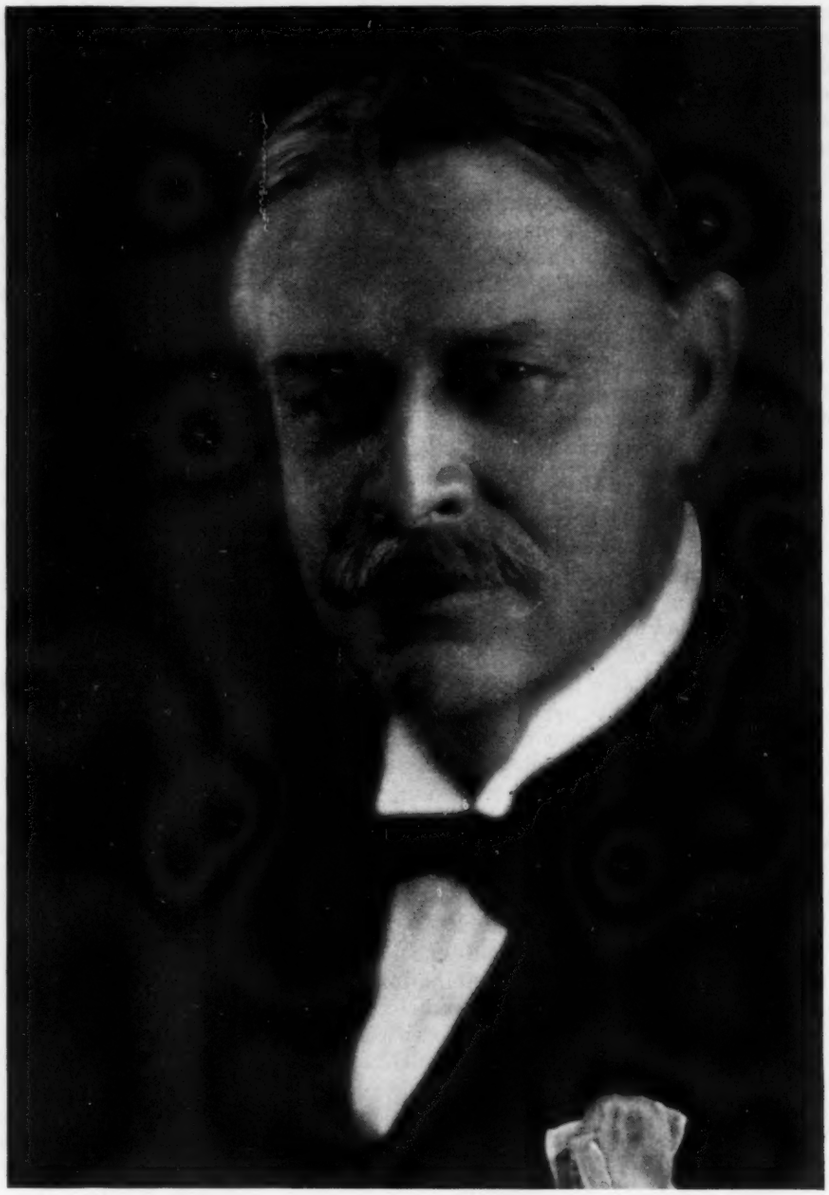
WELL-AIMED publicity, attractive newspaper advertising, interesting lectures and similar activities, commendable as they are, form only a part of any comprehensive program for improving public relations. The main factor goes deeper and is based on the proper co-ordination of the duties of employees, their efficient and intelligent execution and a spirit of courtesy, loyalty and enthusiasm in the company's own ranks. Without this spirit the mere formulation of rules and issuing of orders will be of limited effect, and spoken and printed words addressed to the public may fail to reach their mark.

What lies back of most discontent on the part of employees? Regardless of how it is expressed, it can usually be attributed to dissatisfaction with their salaries or to inharmonious working conditions. When the attitude of the executives to the department heads and of the latter to their subordinates is uniformly courteous and just, when responsibilty and authority are properly co-ordinated, when company "politics" in any wrong sense is rendered fruitless when no real cause for internal jealousies is allowed to remain, when the organization is built up as far as possible from within, suggestions for improved service are welcomed and meritorious ones are rewarded, counsel and help are given, and, above all, when earned wage increases are bestowed without the need for solicitation, let alone importunity, loyalty and contentment follow. These things accomplished, it is then time to consider whether anything more is necessary. Sick and death benefits, pensions, insurance, provisions for entertainment and athletic sports are welcomed by most employees, whether the expense is borne in whole or only in part by the company, though there will be some who will secretly resent anything smacking of paternalism. No universal method, however, can be prescribed. Each company must decide for itself how far to go along these lines.

But even when the right spirit pervades the company's force some employees will need training regarding the finer qualities of human relations. As a basis for organizing public relations work inside a company, the following points of public contact may be emphasized: Answering telephones, receiving applications for service, installing service or wiring premises, reading meters, collecting bills, adjusting complaints, testing meters, replacing fuses, selling domestic appliances, and repairing equipment. In dealing with industrial customers there are such additional points as handling orders for rush service and explaining rates and methods of metering. In some companies departmental experience meetings are held in which employees relate how they met dissatisfied or irritated customers and left them friends, and this method has been found to provide the ground to award prizes for tactful handling of customers and teaching others how to do likewise.

George Clinton Ward

Hydro-electric engineer and able executive who knows how to build railroads and tunnel great mountains



"WHAT should be done can be done." This is one of the maxims that have guided George C. Ward, vice-president of the Southern California Edison Company, through a notable career of engineering. His ability to organize large construction jobs and to conquer the forces of nature, his capability as an executive, the power to pick the proper men, to develop their initiative and to hold their respect, have brought to him the credit of having completed one of the largest construction projects of its kind ever undertaken, the boring of the Florence Lake Tunnel.

While vice-president of the Pacific Light & Power Corporation Mr. Ward made a trip in 1911 to what is now known as the Big Creek-San Joaquin River project of the Southern California Edison Company with Henry E. Huntington, who at that time was forced to seek the development of large blocks of power to operate his railway system in southern California. Mr. Ward made a complete study of the hydro-electric resources of the region and after overcoming seemingly insurmountable obstacles in the matter of transportation of materials and supplies to the High Sierras of Central California he constructed the Huntington Lake reservoir and the chain of Big Creek hydro-electric plants, now widely known.

When the Pacific Light & Power Corporation and the Edison company were consolidated in 1917 to form the Southern California Edison Company, Mr. Ward became vice-president in charge of construction and operation of the greater organization. In this capacity he undertook and carried to completion the task of driving a 13-mile tunnel with a bore of 15 ft. under Kaiser Range in the Sierras.

Mr. Ward was born at White Plains, N. Y. After graduation from Phillips Academy at Andover, Mass., he entered the employ of the North River Construction Company, which was then building the West Shore Railroad. He was connected with the operating department of the road for some time after its completion and for the ensuing eight or nine years was associated with Dr. W. Seward Webb.

It was during his association with Dr. Webb that he attracted the attention of Collis P. Huntington, builder of the Southern Pacific Railroad. The confidence which Mr. Huntington had in Mr. Ward's judgment led to his association with Henry E. Huntington.

Mr. Ward is a student of archæology and is well versed on the life and habits of some of the Indian tribes of the Southwest. He is a member of the A. I. E. E.

User's View of Oil Circuit Breakers*

Outline of the Situation from the Operator's Standpoint, Particularly with Reference to Interrupting Duty—Possibilities for Improved Applications and Necessity of Adequate Maintenance

By E. C. STONE
Planning Engineer Duquesne Light Company, Pittsburgh, Pa.

THE RATING of an oil circuit breaker includes normal voltage, normal current, normal frequency, maximum momentary current which the breaker can withstand and interrupting capacity. Of these items, all except the last are perfectly simple and not subject to argument. Hence, interrupting capacity is the only item of rating which is involved in the following discussion.

The interrupting duty imposed upon an oil circuit breaker when it opens a circuit depends on the intensity of arc between contacts, which is a function of magnitude of current interrupted, and on the duration of arc, which is a function of the voltage tending to maintain the arc—that is, the "recovery voltage" which appears across the terminals of the switch at the moment the arc is interrupted.

After a breaker has opened the circuit, the gas pressure disappears in a comparatively short time, as the gas escapes through the vent, but the burning of contacts, carbonization of oil and depositing of carbon on insulated surfaces inside the tank are accumulative. That is, every time a circuit breaker opens a circuit through which current is flowing, the arc produced causes burning of contacts, oil carbonization and carbon deposit, which affect a definite reduction in the interrupting capacity of the breaker. After a sufficient number of circuit openings, interrupting capacity of the breaker is exhausted and can be restored only by repairing contacts, cleaning inside insulating surfaces and replacing old oil with new.

The loss of interrupting capacity of a breaker as it operates may be likened to loss of capacity in a storage battery as it discharges. After a certain duty has been performed, the breaker, like the storage battery, becomes exhausted. As the duty is intensified, the life of the breaker is shortened, just as the life of the battery is shortened on heavy load duty. Again, just as the battery may be recharged after its life has been run, so a breaker can be brought back to its original rating by a little simple and inexpensive maintenance.

The essential features of design which determine interrupting capacity are:

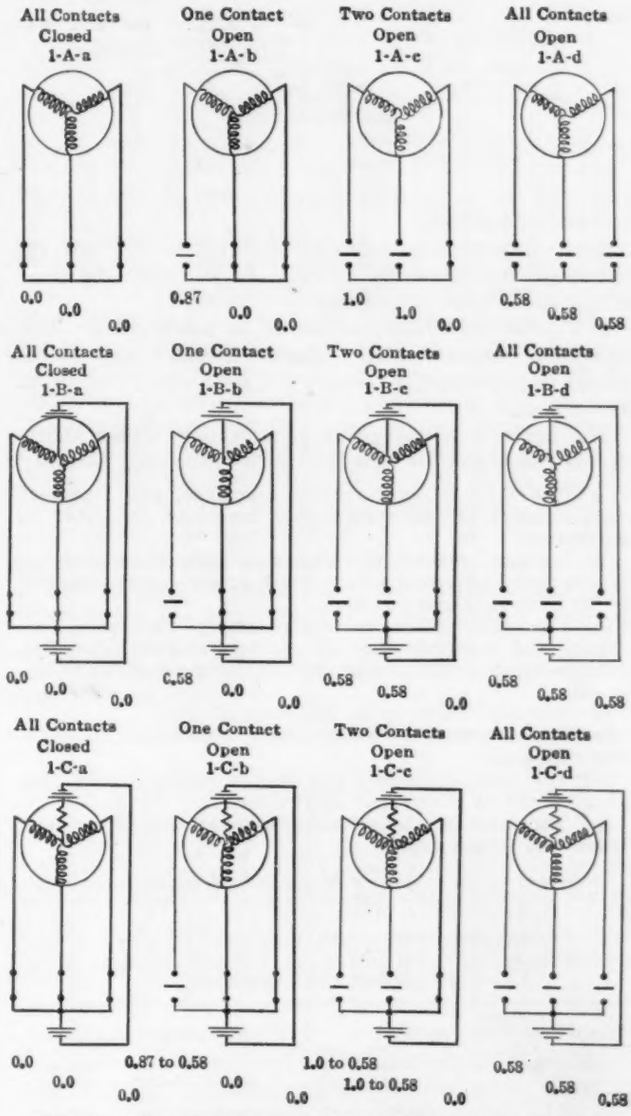
1. For interruption of arc: Contact break distance, speed of contact travel, contact pressure and magnetic blow-out effect.

2. For absorption of energy of arc (gas pressure): Volume of oil, oil head above contacts, air space above oil, venting.

3. Mechanical strength: Great mechanical strength is required throughout to withstand the strains due both to pressures developed by release of gas and to electromagnetic effects of the heavy currents handled.

4. Thermal capacity: All current-carrying parts must have sufficient thermal capacity to carry the maximum currents while they last.

Operating tendency is to require increased thermal capacity to take care of the longer duration of short-



FIGS. 1 TO 3.—RELATIVE RECOVERY VOLTAGES FOR VARIOUS SYSTEM CONDITIONS

Fig. 1—Generator neutral grounded or ungrounded, fault ungrounded.

Fig. 2—Generator neutral solidly grounded, fault solidly grounded.

Fig. 3—Generator neutral resistance grounded, fault grounded.

In Figs 1 to 3 the numbers directly under the breaker contacts give the normal voltages, expressed in decimals of normal system line voltage, which will exist across the respective contacts under the conditions shown. Under usual operating conditions, these values may be assumed as the limiting normal frequency voltages on which interrupting rating should be based. The parts of the circuit in which short-circuit current flows are shown by heavy lines.

*Abstract of paper presented at the Annual Convention of the A. I. E. E., Saratoga Springs, June 22-26, 1925.

circuit current due to the higher relay settings used for obtaining selectivity of circuit-breaker operation and for taking advantage of the current decrement curve of the synchronous equipment.

5. Oil quality.

Opinion is divided as to the value of high-speed contacts, explosion chamber, multiple contacts in series and resistance introduced into breaker circuit to reduce energy released by arc in breakers. Opinion is also divided as to the best means of absorbing the gas pressure, and the various designs take care of this feature by various methods.

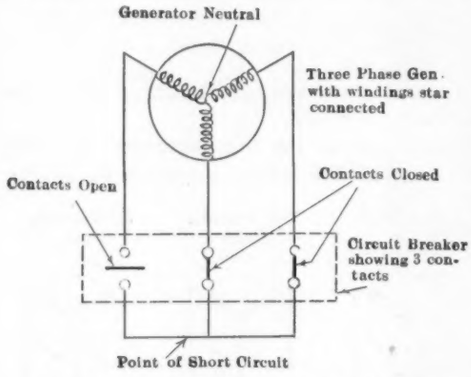


FIG. 4—ARRANGEMENT OF CIRCUIT FOR RECOVERY VOLTAGE DIAGRAMS

Since interrupting capacity depends on current interrupted and recovery voltage, the interrupting duty in any case varies with these two factors:

1. Factors affecting current to be interrupted: The maximum current which a circuit breaker may be required to interrupt is obviously a dead short circuit at its terminal.

The current at any point of a system, under short-circuit conditions, is affected by the following factors:[1]

(*a*) The total kilovolt-ampere reactance, and transient characteristics of the synchronous machines connected to the system.

(*b*) Number, reactance, resistance, capacitance and arrangement of all circuits over which power can be supplied to the point of short circuit.

(*c*) The kilovolt-ampere arrangement, resistance, reactance and capacitance of all reactors and transformers, through which power can be supplied to the point of short-circuit.

(*d*) Contact resistance at the short circuit.

(*e*) The nature of the short circuit, whether single-phase or multi-phase.

(*f*) The kilovolt-ampere and power factor of the load being carried at the time of short circuit.

(*g*) The point of the pressure wave at which the short circuit was established.

[1]Items (*a*) to (*h*) listed herein are taken from the paper "Rating and Selection of Oil Circuit Breakers," by Hewlett, Mahoney and Burnham, A. I. E. E., 1918.

TABLE I—FIELD TESTS ON OIL CIRCUIT BREAKERS OF HIGH INTERRUPTING CAPACITY

Normal Line Voltage, Kv.	Limiting Recovery Voltage (See Note) Kv.	Maximum Kva. Three Phase Interrupted	Amperes per Pole	Grounding Characteristic	
				System Neutral	Short Circuit
132	77	725,000	3,150	Dead Grounded	Grounded
110	63	542,000	2,850	Dead Grounded	Grounded
44	44	280,000	3,660	Dead Grounded	Ungrounded
44	25	246,000	3,220	Dead Grounded	Grounded
24	14	580,000	14,000	Dead Grounded	Grounded
23	23	450,000	11,400	Grounded through Resistance	Grounded
13	7.5	545,000	23,700	Dead Grounded	Grounded

Limiting recovery voltage, as used in this table, is defined as the maximum or limiting normal frequency recovery voltage which can appear across the contacts of one switch pole after the arc is interrupted, under the grounding conditions existing in the test. On the actual tests the recovery voltage did not in any case reach the full limiting value as given here, even taking into account such higher frequency harmonics as were developed.

(*h*) The use of automatic voltage regulators.

(*i*) Conditions as to grounding of system neutral and grounding of short circuit.

(*j*) Elapsed time from first cycle of short circuit to interruption of arc on breaker contacts.

2. Factors affecting recovery voltage. Very little consideration, so far, has been given to these factors, although they are fully as important as those affecting current. The most obvious are:

(*a*) Phase angle between interrupted current and recovery voltage.

(*b*) Conditions as to grounding of system neutral and grounding of short circuit.

(*c*) The kilovolt-ampere and power factor of the load existing at the time of short circuit.

(*d*) Arrangement and characteristics of circuits and apparatus.

The effect of item (*a*) has been discussed in a previous paper[2]. Under ordinary operating conditions item (*c*) should not vary sufficiently to affect radically the interrupting duty of the circuit breakers. The effect of item (*d*) is to cause a high-frequency transient voltage to be superimposed on the normal frequency recovery voltage, as a result of the discharge of stored energy in the system. Comparatively little data are available on the magnitudes of these transient voltages under varying system conditions—in most cases, however, it does not seem probable that they will increase the interrupting duties on breakers beyond the factors of safety intended to be in the breaker ratings.

Conditions as to grounding of system neutral and grounding of short circuit—item (*b*)—however, have very marked effect on the recovery voltage and therefore on the interrupting duties imposed on the breakers. The relative values of recovery voltage under the various possible grounding conditions are shown in Figs. 1 to 3.

For the study of problems in economics of system design a series of curves showing comparative costs of oil circuit breakers has been compiled. These curves are based on present-day prices and are believed to present a fairly accurate picture of the relation of costs to interrupting ratings as a whole, although in some individual cases the price of a given breaker may be considerably out of line. These curves are shown in Figs. 5 to 7.

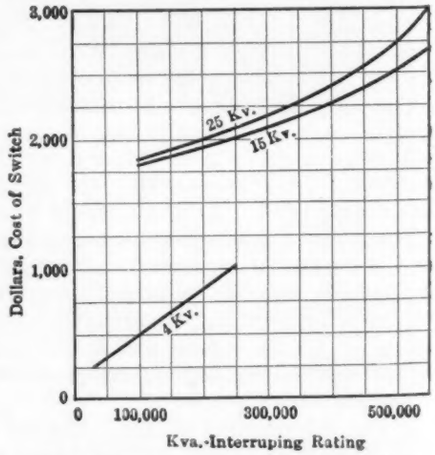


FIG. 5—COST VS. INTERRUPTING RATING FOR OIL CIRCUIT BREAKERS 25 KV. AND BELOW

On low-voltage breakers interrupting capacity is the chief factor in determining price, while voltage has less effect. Thus, a 15-kv. breaker of 300,000-kva. interrupting capacity costs approximately 16 per cent more than a 15-kv. breaker of 130,000-kva. capacity, while a 25-kv. breaker of 500,000-kva. capacity costs only 9 per cent more than a 15-kv. breaker.

[2]"The Rating and Selection of Oil Circuit Breakers," by Hewlett, Mahoney and Burnham, A. I. E. E., 1918.

On high-voltage breakers, however, voltage is the chief factor in determining the price, while interrupting capacity has a lesser effect. Thus, a 37-kv. breaker of 1,500,000-kva. capacity costs approximately only 28 per cent more than a 37-kv. breaker of 750,000-kva. capacity, but a 73-kv. breaker of 750,000-kva. capacity costs approximately 60 per cent more than a 37-kv. breaker of the same capacity, as is also shown in Fig. 6.

Interrupting ratings of oil circuit breakers are admittedly maximum ratings, hence breakers cannot be expected to function properly even slightly beyond their ratings. It is understood, however, that these ratings are based on interrupting an ungrounded short circuit, under which condition the normal frequency recovery voltage is a maximum, Fig. 1.

Interrupting ratings are based on a constantly increasing fund of knowledge resulting from tests in factory and field and from operating experience. Special attention is called to the exhaustive factory tests made by one manufacturing company. Some of the interrupting duties under which breakers have been tested in the field are shown in Table I.

So far as the writer has been able to ascertain, no field tests have been made where more than 725,000 kva. has been interrupted. Most of these field tests, as shown in the table, have been made on grounded short circuits in systems with dead-grounded neutral. In such cases the recovery voltage is approximately only 58 per cent of that on a system with neutral ungrounded or grounded through a high resistance. The interrupting duty under such tests was therefore only about 58 per cent of that which would have been imposed if the tests had been made on systems with high resistance instead of dead-grounded neutral. In general, also, tests were made under conditions where the transient voltage resulting from the interruptions of the short circuit have been very small, but on the other hand, metallic short circuits were used, which would give more severe conditions than probably exist ordinarily.

Oil circuit breakers, with their designs based on the results of tests within the range of their interrupting rating, may be expected to perform satisfactorily up to these ratings, where they are installed under system conditions similar to those under which the field tests

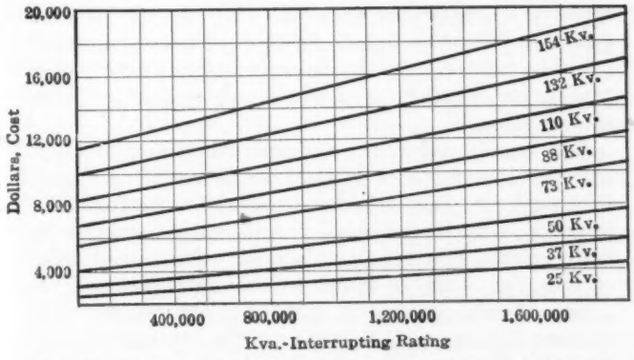


FIG. 6—COST VS. INTERRUPTING RATING FOR OIL CIRCUIT BREAKERS OF 25 KV. AND ABOVE

were made, particularly in regard to conditions as to grounding of system neutral and grounding of short circuits which the breaker must interrupt.

For ratings beyond the range of tests, it must be clearly borne in mind that very little direct data have been obtained and that designs are based on data deduced from tests made on lower interrupting duties. It remains to be seen how accurate the conclusions thus drawn will prove to be.

In oil circuit breakers for high voltages, the tank size is determined by the voltage rather than by interrupting duty. It is quite possible that the interrupting capacity of high voltage breakers may prove to be larger than expected for this reason.

All published interrupting ratings are now based on the standard operating duty approved last year by the

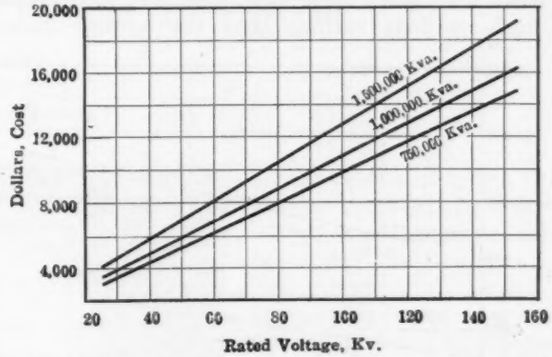


FIG. 7.—COST VS. VOLTAGE RATING FOR OIL CIRCUIT BREAKERS INTERRUPTING RATINGS OF 750,000 KVA. TO 1,500,000 KVA.

protective devices committee and printed in the A. I. E. E. *Journal* for October, 1924.

Referring to the standard definition of interrupting rating on which the standard operating duty is based, it is probable that the term "normal voltage" will require further definition in view of the wide differences in the recovery voltage which may prevail with the same normal system voltage. Meanwhile it is assumed, as stated above, that this term is interpreted to mean that the switch will be able to perform its full operating duty under the conditions which will give a recovery voltage up to the magnitude that results when the short circuit is ungrounded. It is not clear, at the present time, whether this is always the case. Further attention must also be given to the relative interrupting ratings of the same circuit breaker under different operating duties.

The following relative ratings have been proposed by the Power Club:

	Per Cent
(*a*) One-unit operating duty. Rating varies between limits given with design of breaker.	100 to 125
(*b*) Two-unit operating duty, 2-minute intervals (standard duty)	100
(*c*) Four-unit operating duty, 2-minute intervals	70
(*d*) Four-unit operating duty, ½-minute intervals	60
(*e*) Four-unit operating duty, no time intervals	25
(*f*) 300-unit operating duty 15-minute intervals	30
(*g*) Four-unit operating duty, successive intervals of 0, 30, 75 seconds	30
(*h*) Four-unit operating duty, successive intervals of 15, 30, 75 seconds	40
(*i*) Three-unit operating duty, 1-minute intervals	70

It is recommended that operating duties (*d*), (*e*), (*g*) and (*h*) be confined to oil circuit breakers having interrupting ratings on standard operating duty not over 25,000 kva. and voltage ratings not over 37 kv.

Taking these figures as a basis, it is probable that a breaker that will perform satisfactorily under operating duty (*a*) or (*b*), one or two interruptions, will also perform satisfactorily on any of the other operating duties at the percentage rating given. On the other hand, it does not seem at all certain that a breaker which will satisfactorily interrupt the lower values on multiple interrupting duty will also be able to interrupt the higher capacities of the one or two interruption operating duties on the percentage relation shown in the table.

The relative costs of obtaining interrupting capacity when using breakers at voltages below their normal rating are shown in Fig. 8. Thus, while a 37-kv. breaker of 1,150,000-kva. interrupting rating will cost $5,000, a 73-kva. breaker, giving the same interrupting rating on 37-kv. operation will cost $7,300, an increase of 46 per cent. The effect of this relation of ratings is to make very much more expensive the use of breakers of higher-voltage ratings than the normal operating

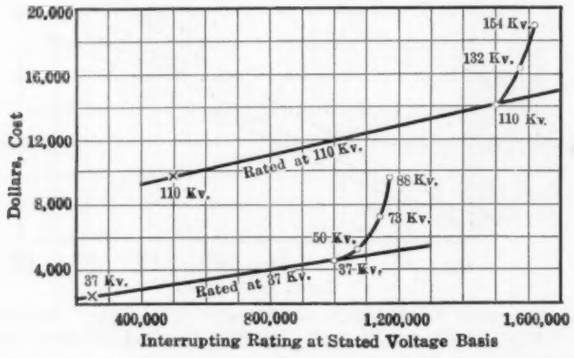


FIG. 8—COMPARATIVE COSTS OF INTERRUPTING RATINGS IN OIL CIRCUIT BREAKERS OPERATED AT VOLTAGES BELOW NORMAL

voltage of the system in which they are connected, although such practice becomes vitally necessary on some systems.

Tests are still urgently needed to prove performance at greater interrupting capacities, and it is hoped that the operating companies will continue the practice of testing oil circuit breakers at progressively greater interrupting duties.

In considering the application of an oil circuit breaker to a specific situation, the maximum interrupting duty must be determined by calculation of maximum current to be interrupted and maximum recovery voltage. The interrupting rating of the breaker specified will depend upon the maximum interrupting duty as thus determined and the particular operating duty which will be demanded of the breaker in service. At the present time conservative practice requires that calculations be made on a basis that will give a maximum interrupting duty equal to or somewhat higher than that which can actually be imposed on the breaker.

Calculation of short-circuit current is thoroughly understood and can be made with almost any desired degree of accuracy.[3] Calculation of recovery voltage is not so well understood. The important factor to be taken account of in determining recovery voltage is the condition as to grounding of system neutral. (See Figs. 1 to 3.) Up to the present time most of the heavy-duty oil circuit breaker experience has been derived from systems with dead or nearly dead grounded neutrals, on which the interrupting duty for a given current is of the order of only 58 per cent of that on a system with ungrounded or high-resistance grounded neutral. Hence on systems of the later type, which are becoming more numerous all the time, it becomes of prime importance to give careful consideration to the more severe conditions.

Up to the present time comparatively little attention has been given to refinement in the application of oil circuit breakers. As the interrupting ratings of breakers becomes more accurate it should be possible to fit breakers more closely to their individual duties. Many factors under operating conditions tend to make the current which must be interrupted on most faults of much less magnitude than the maximum current of a dead short circuit at the breaker terminals. Some of the more obvious of these factors are: Resistance in fault, faults resulting in grounds or three-phase shorts, whereas duty may be calculated on the more severe single-phase line-to-line short, neglect of system resistance in calculating fault currents and, in networks, the interruption of the fault in two or more steps.[4]

When these factors are known and circuit breaker ratings are also accurately determined, it may be found that the maximum conditions assumed in the selection of the breaker at the present time occur so seldom that they may be treated as a special case. This special treatment might involve allowing the breaker to function above its rating in these few instances, or by prescribing a less severe operating duty under especially heavy short circuits, or by installing breakers in group arrangement in such a manner that one breaker of sufficient interrupting capacity to meet maximum duty would be in series with a number of smaller breakers designed for average conditions and would open only when the ratings of the small breakers was exceeded by the short circuit. All of these methods are in use to a limited extent at the present time, but their effectiveness is uncertain, because of lack of exact knowledge as to conditions. Data on actual values of fault currents as experienced in every-day operation, are much needed, and it is believed that if such data could be obtained and analyzed, material savings in overall circuit-breaker investment might be effected.

A number of companies have found it necessary to use breakers designed for normal voltage higher than those of the systems on which they are to be used, in order to obtain adequate factors of safety against insulation failure. On the basis of ratings now standard, this factor of safety is obtained only at marked increase in cost, Fig. 9.

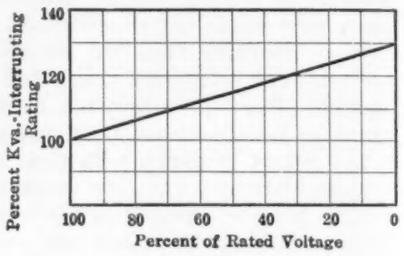


FIG. 9 — INCREASE OF INTERRUPTING RATING OF AN OIL CIRCUIT BREAKER WHEN OPERATED AT A VOLTAGE BELOW ITS NORMAL VOLTAGE RATING

The standard definition of operating duty of a circuit breaker contemplates very clearly that after the rated interrupting duty of the breaker is performed, the breaker is no longer good for its rating until suitable maintenance has been performed. The reasonableness of this condition is found in the explanation hitherto given of what happens within the breakers when a current is interrupted. It is of the utmost importance that this limitation be recognized. An adequate system of inspection and maintenance must be set up if satisfactory service is to be obtained. In this connection it is obvious that the cost of maintenance will be less where the rated interrupting capacity of the breaker is in excess of the maximum duty it is called upon to perform. In circuit-breaker installations, therefore, some consideration should be given to striking a balance between first cost and maintenance cost.

[3] "Application of Decrement Factors in Short Circuit Studies," by W. R. Woodward, *Electrical Journal*, May, 1924.

[4] See discussions on papers on Baltimore tests, especially that by A. F. Bang, A. I. E. E., 1922.

Increasing Revenue per Dollar Invested

Every Utility Department, Whether It Be Engineering, Operating, Financial or Sales, Has Opportunity to Help—Co-ordinated Effort Needed—Can't Peak Demands on Businesses Served Be Reduced by Education?

An Interview With
JOHN F. GILCHRIST
Vice-President Commonwealth Edison Company

AS REFLECTED in past editorials and articles in ELECTRICAL WORLD, electric service company executives have been concentrating much thought on how the revenue per dollar invested in plant can be increased. The increased importance of this problem has come from the increased cost of everything which goes into electric service and the fact that rates have not been increased commensurately therewith or, if at all, to only a small extent compared with other services and products.

JOHN F. GILCHRIST

Representing a company that has more money invested in a single location than any other in the United States, John F. Gilchrist, vice-president of the Commonwealth Edison Company, was interviewed by a representative of ELECTRICAL WORLD to ascertain how the problem might be solved. Mr. Gilchrist pointed out some of the measures that have been applied separately and also some relatively new ideas, emphasizing that the problem will not be solved through any one approach, but through co-ordinated concentrated effort.

Briefly outlining the present situation, Mr. Gilchrist said: "Whereas medium-size generating stations were once built for $75 per kilowatt and larger ones for $60, the latter now cost more nearly $115, or nearly double pre-war prices. Transmission line and distribution systems have likewise gone up in cost, making the fixed charges on electric-service companies' plants much larger than ever before. Of course economies have been effected that enable obtaining more kilowatt-hours per pound of coal burned, and load factors have been gradually improved to enable turning out more kilowatt-hours per kilowatt of generating equipment installed. But still the net revenue per dollar invested is far from what is desired.

"It therefore behooves all utility men, from the chief executive down through the department heads and every department representative to consider ways of securing a better return per dollar invested, since each one must account, directly or indirectly, to the investors in public utility securities for the best use of the money invested in the plant and to the public for the rates that are charged for energy. Design engineers, operating men, rate experts and salesmen, all have their opportunity in their particular lines. It will be a composite of their efforts that will bring the much-needed results."

"What does securing more revenue per dollar invested per kilowatt require?" Mr. Gilchrist was asked, to which he replied:

"It involves developing a load which is as near that which could be carried continuously by the maximum generator capacity as may be attained in practice. Some opportunities through which this ideal may be partially attained are: (1) interconnection of adjacent plants and systems; (2) fewer shutdowns of equipment due to repairs and overhauling; (3) laying out and loading distribution systems so that the load will be more nearly uniform; (4) developing loads that will consume a large amount of energy per kilowatt of demand during the system peak; (5) stimulating an interest among businesses of all characters in cutting down peak demands on their own businesses as a means of reducing their overhead expenses and increasing profits; (6) urging a differential in starting and stopping hours of certain groups of industry by showing them a selfish interest. Practically all of these methods except the last two have been followed separately for years, but there is more necessity than ever for concentrating attention on these and other methods that may be devised and for carrying them out in a concerted, co-ordinated manner.

"Through interconnection, as nearly everyone in the utility business knows, more revenue per dollar invested per kilowatt can be obtained through lessening the necessity for so much reserve capacity, exchange of surplus energy, development of greater diversity factor, ability to concentrate loads on the most efficient plants, and delaying the building of new plants.

"Shutdowns of equipment for repair and overhauling can be greatly reduced by systematic inspection and maintenance, which will anticipate serious causes for shutdowns of revenue-producing equipment for long

periods. The increasing attention being given to causes of shutdowns and the establishment of systematic, periodic inspection and maintenance schedules is a step in this direction.

"While business-getting staffs have probably always considered the value of high-load factor, off-peak and high-diversity factor business, there is the human tendency to seek that business which is easiest to obtain. Loading up a system with such business, if there is any surplus peak capacity available, will bring in more revenue, but will not increase the revenue per kilowatt of generating capacity to the point where it might be brought if the system load factor is still further improved. Companies with surplus peak capacity may possibly be able to afford the delay of special attention to system load factor improvement, but hardly the company which has its plant loaded to peak capacity already.

"Not only will it be advisable to analyze and classify the characteristics of typical prospective loads for shape of daily doad curve as compared with the system load, but those loads which are particularly adapted to fit into the system load curve or which in combination with other loads will consume a large amount of energy per combined demand during the system peak load will have to be more zealously sought and encouraged than ever before. Such an analysis might compare the kilowatt-hours consumed per day per kilowatt of demand during the system daily and yearly peaks (instead of during the individual load peak) and classify them as to desirability. The analysis of prospective loads might advantageously include a classification that would enable the ready determination of the load that could be easily served from existing distribution lines without extensions or reinforcement, to enable seeking loads that would make the best use of the investment in distribution systems.

"Aside from classification of load by industries, on which a sales program would be built, it may be advisable similarly to classify the load of certain known, individual and commercial usages of electricity, to ascertain what specific applications could be developed, with the idea of developing greater revenue per kilowatt of peak generating capacity. These loads would include night battery charging and various uses of electric heat for industrial and commercial purposes, such as heat treating, industrial and commercial baking. Analysis of what might be advantageous to do without carrying out the idea is hardly worth the expense, however.

"Stimulating an interest among businesses of all characters to cut down the peak demands on their own services as a means of reducing overhead expenses and increasing profits has probably not been considered seriously before," pointed out Mr. Gilchrist, when questioned on this new idea, "because it is a task of such magnitude that one utility company could hardly shoulder it alone with success. Still, all businesses labor under the same handicap as utilities in having peak demands that require larger operating forces and space accommodations than if the demands on their services were more uniformly spread out over each day and year.

"Fortunately this fact has gained the serious consideration of the United States Chamber of Commerce, and the solution of the problem would be in line with Secretary Hoover's movement to reduce the cost of distribution. With this recognition by national forces, there are hopes that peak demands on all businesses may be gradually decreased (and consequently those in the utility business) if every commercial and industrial organization in the country will give serious individual and collective thought to the exorbitant and unnecessary expense of such a situation and how it can be rectified. Utilities, because they have had to consider means of increasing the load factor, should be in an excellent position to give some definite suggestions of principles required in overcoming peak loads which can be applied to other businesses. Rid of their technical verbiage, the principles applied in the utility business have many parallels in other businesses.

"While it may be argued that the human relations problem—namely, the insistence of the public to shop *when* it desires—is an insurmountable obstacle for organizations doing business with individuals, it is believed that a close parallel of this problem of overcoming human inertia has been solved at least in part by the utility field in dealing with industrial, commercial and domestic customers. The method resolves itself into convincing the individual of some special advantage which he will derive from the change of practice. It may be speed of delivery, increased attention which can be given, improved quality of service, or maybe a differential in the price for confining demands for service to off-peak periods. As stated before, there will be an opportunity for utilities to suggest the principles that can be applied. The individual business will be in the best position to determine just how these principles can be applied specifically.

"By working hand in hand with any national organization or organizations fostering such a movement and by locally and publicly discussing the advantages, utilities can help bring a much-needed benefit to commercial and industrial institutions in their localities as well as nationally and eventually reap a benefit to utilities themselves through the elimination of the causes of peak demands, and consequently the present low return per dollar invested in utility systems."

Lighting System of Paris Exposition Rated at 10,000,000 Cp.

THE Compagnie de Distribution d'Électricité de Paris has installed an elaborate transmission system for the Decorative Arts Exposition on the banks of the Seine in the heart of Paris. A substation, henceforth to be known as the Fabert station, has been equipped on the Place des Invalides. Its total rating is 8,000 kw. Alternating current is brought at 12,000 volts from the Issy-les-Molineux generating station, supported in case of need by Saint-Ouen. The transformed current is carried at 3,000 volts to the exposition on both sides of the Seine by seven trunk lines leading to forty-three transformers in various sections of the grounds. More than three hundred individual exhibitors, aside from the exposition itself, use electricity in the grounds, giving a total lighting load in excess of 5,000,000 cp. The official lighting arrangements within the grounds call for energy totaling 2,700,000 cp., and for outside lighting and the illuminated fountains of the Alexander Bridge another 1,650,000 cp. is required. In all, the lighting system for the Exposition calls for 10,000,000 cp. in addition to the regular Paris demand.

The Issy and Saint-Ouen central stations in the ten years since their establishment, and in spite of the war, have seen their subscribers increase from 146,000 to 442,000 and the consumption of energy go from 76,000,000 kw.-hr. to 356,000,000 kw.-hr.

Two-Phase, Five-Wire Distribution*

Engineering and Economic Elements Investigated as to Fundamental Requirements, Such as Service Continuity, Safety, Standard Voltages, Flexibility, Low Cost, Etc.

By P. H. CHASE

Assistant Engineer Transmission and Distribution Philadelphia Electric Company

THE fundamental requirements which must be met by any secondary distribution system, in order to meet the requirements of the customer with safety and economy, are:

1. *Service Continuity.* A high degree of service continuity is required for all classes of service. This is afforded by various feeder, main and service combinations with their requisite protective equipment to afford the desired service insurance.

2. *Safety.* For a secondary distribution system, the requirement for safety is met, according to present accepted ideas, by a service voltage of approximately 115 from any wire to ground. Existing wiring standards and appliances allow this voltage to be handled safely for a wide diversity of applications.

3. *Standard Voltage.* The voltage for lamps has been standardized at 115 volts, with 120 volts as an allowable higher figure. The voltage for motors for combined light and power systems has been standardized at 110 and 220. Any system of distribution should conform to these basic voltage standards, established through years of experience and investigation.

4. *Voltage Regulation and Balance.* The inherent voltage regulation and balance of the secondary distribution system must be such that, with the usual voltage-regulating equipment at the substation, the variations of service voltage, on all phases and under all load conditions, will be kept within a value which will not impair illumination from lamps nor service from motors and appliances.

5. *Customers' Equipment and Wiring.* The type of distribution system should be such that the customers' equipment may be of standard, readily secured types and the wiring simple, efficient and inexpensive.

6. *Simplicity and Standardization.* Separate or combination light and power service should be readily available from a single set of mains in order to take the maximum advantage of diversity between power and lighting loads. The distribution system should make use of standard equipment.

7. *Load Balance.* The secondary distribution system should be readily adapted for service both to single-phase and to polyphase loads without material load unbalance between the phases.

8. *Voltage Balance.* The voltages of the different phases should remain balanced with respect to each other and to ground.

9. *Adaptability to Physical Conditions.* The distribution system should be equally adaptable to aërial or underground construction, to urban, suburban and rural conditions, and to residential, commercial and manufacturing districts.

10. *Growth Adaptability.* The secondary distribution system should be adaptable to all stages of load growth and load density, by means of additions and reinforcement, and with the minimum amount of reconstruction work at any stage.

11. *Investment.* There should be the minimum investment in mains, services, transformers, meters, etc. The annual charges on the investment are usually the largest portion of the total annual cost of the secondary distribution system.

12. *Power Losses.* The secondary distribution system should have low power losses. This requirement is usually met when the requirements for voltage regulation are properly met.

13. *Operating and Maintenance Costs.* These costs should be low. They usually will be a fairly constant percentage of the investment.

The treatment of the subject throughout is based on the requirement of a system suitable for the supply of power and lighting, either single phase or polyphase, from the same mains. A study of the economic advantages of combination mains, under assumed average conditions, points toward savings of the order of 20 per cent in the total annual cost (fixed charges and losses) of transformers, mains and services, as compared with separate transformers, mains and services

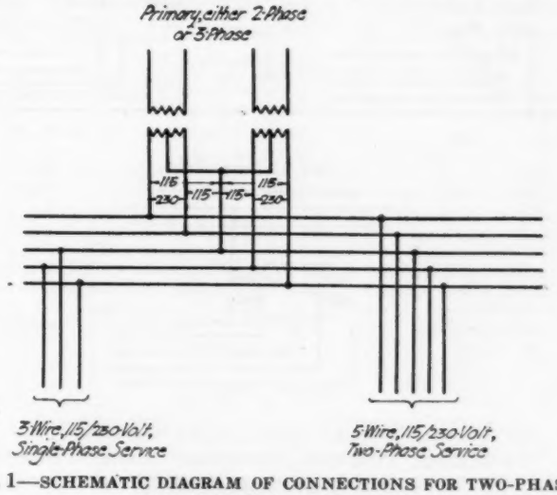


FIG. 1—SCHEMATIC DIAGRAM OF CONNECTIONS FOR TWO-PHASE, FIVE-WIRE SECONDARY MAINS

for lighting and power. It is recognized that there are and will be many instances, particularly on aërial systems, where the use of separate lighting and power mains is necessary to prevent fluctuating power loads or the frequent starting of motors from impairing lighting service, and that on many systems the mileage of separate lighting and power mains greatly outweighs the mileage of combined mains.

The two-phase, five-wire secondary system is shown schematically in Fig. 1. The system is strictly a four-phase, five-wire diametrical system, with 115 volts to neutral. This diametrical connection is responsible for many advantages of the two-phase system, owing to the relative independence of the phases. If there is any virtue in the number of phases, surely such a four-phase system should compare favorably with the three-phase.

The two-phase, five-wire system has the following outstanding features: (1) Standard 115 volts for lamps and appliances, (2) standard 115 volts or 230 volts for motors, (3) voltage to ground balanced, (4) load balanced, (5) two transformers per bank and (6) transformers of standard ratio and voltage.

Considering the secondary distribution problem from

*Abstract of paper presented at the annual convention of the A. I. E. E., Saratoga Springs, June 22-26, 1925.

a fundamental point of view, it will be realized that the condition which largely influences the economic advantages of one system over another is the amount of power carried per wire. Table I shows the amount of power per wire for various systems, all with 115-volt lamp voltage (E), assuming the same current (I) per wire and the same size wire. This comparison is based on equal voltage drop and therefore represents equivalent conditions for the distribution systems set forth.

The two-phase, five-wire system carries 6.6 per cent greater power per wire because, with 20 per cent more copper, it carries 33⅓ per cent more power than the three-phase, four-wire system having the same lamp voltage.

INHERENT ADVANTAGES

Consider the inherent advantages of the two-phase, five-wire system:

1. It has a fifth or neutral wire common to two independent 115/230-volt phases. A current in the neutral is caused

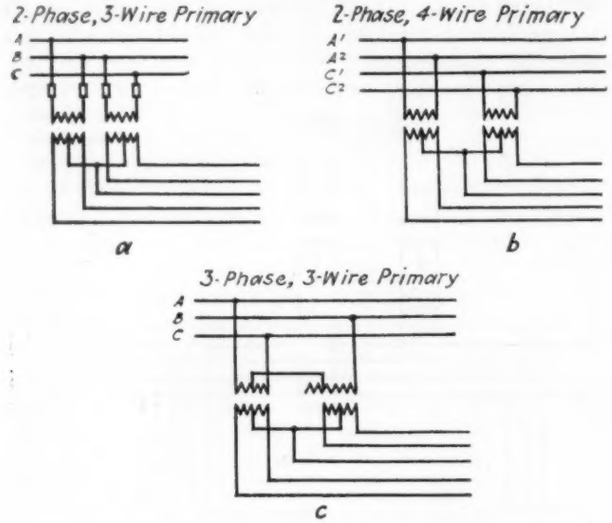


FIG. 2—TRANSFORMER CONNECTIONS FOR SUPPLYING TWO-PHASE, FIVE-WIRE SECONDARY MAINS FROM TWO-PHASE OR THREE-PHASE PRIMARY CIRCUITS

only by a load unbalance on one side of a phase, and this is ironed out in the transformers.

2. The neutral of the three-phase, four-wire star system, and also the transformers, will carry the resultant current due to any line—neutral load unbalance, and thus transfer the unbalance to the primary mains.

3. In a secondary distribution system, which ordinarily supplies both single-phase and polyphase loads of various types, there is inevitably unbalance between line and neutral loads, and the effect of this upon the voltage balance of the system is inherently greater with the three-phase, four-wire star system than with the two-phase, five-wire system.

4. In the aërial plant, standard crossarms and racks can be utilized practically as efficiently by the two-phase, five-wire system as by the three-phase, four-wire system. Four wires utilize practically as much space as five wires and the four wires will have to be larger for the same amount of power carried under the same conditions.

5. In the underground plant the two-phase, five-wire system can make use of single conductor, two-conductor, three-conductor or four-conductor cable as local duct, heating, loading and service conditions warrant. Under many conditions, where it is economically preferable to install mains on two sides of a street, the two-phase, five-wire system affords a very flexible method of rendering service to loads largely single-phase on each side of such a street while still maintaining balanced load on the mains and phases.

6. With heavy load densities, the two-phase, five-wire system may readily be accommodated with one phase in each of two ducts. There is a consequent improvement in the transmission of heat from the cables and a decrease of the hazard to service from one phase in the event of a fault on the other phase. The three-phase, four-wire star system requires a voltage unbalancing arrangement of the cables if two ducts are used, unless all three phase-conductors are in each duct.

TABLE I—POWER PER WIRE

System	No. of Wires	Power Carried	Power Carried per Wire
Five-wire 2 ϕ 115/230 volt	5	$4EI$.	$4/5\,EI. = 0.80\,EI.$
Four-wire 3 ϕ 115/199 volt	4	$3EI$.	$3/4\,EI. = 0.75\,EI.$
Three-wire 1 ϕ 115 230 volt	3	$2EI$.	$2/3\,EI. = 0.667\,EI.$
Two-wire 1 ϕ 115 volt	2	EI.	$1/2\,EI. = 0.50\,EI.$*

* Voltage regulation requirements will often operate to reduce this value as a comparative measure of power per wire.

Although local conditions will materially affect the handling of any underground system, it is felt that the two-phase, five-wire system has at least every advantage that the three-phase, four-wire has in best utilization of pole and duct space.

On the other hand, the three-phase, four-wire secondary system forces the distribution engineer into a choice of one of the following dilemmas:

1. A decrease in the motor service voltage to 199 volts nominal, with 115-volt lamp voltage. This may require the development of a new line of motors, or the derating or underloading of the present line of 220-volt motors.

2. An increase in the lamp voltage to 133, thus bringing the motor service voltage to 230. This requires the introduction of a new line of lamps and appliances and a new line of distribution transformers, or the marked over-excitation of the present standard ratio transformers to give 133 volts, secondary. Also changes to present standards for substation equipment might be necessary.

3. A compromise raising the lamp voltage to around 125, and decreasing the motor voltage to around 216. This presents complications with lighting, appliance and motor loads, as the compromise voltages are often high for lamps and appliances and materially, if not seriously, below the 230-volt standard for motor service.

4. The use of auto-transformers for stepping up the main voltage of 115/199 to 230 volts for motors. Under conditions where the lighting and power loads on a secondary main system are approximately equal, it would then be necessary to transform one-half of the load from 115/199 volts up to 133/230 volts by means of auto-transformers. Assuming an average connected load per power customer of 12.5 kva. in power, a fair average figure for an underground city area, it is estimated that the necessary auto-transformers, (excluding installation costs) would cost more than 25 per cent of the entire investment in secondary mains, conduits and manholes.

The service which on the two-phase, five-wire system would be three-wire 115/230 volts single-phase, on the

TABLE II—COMPARATIVE COST OF AËRIAL TRANSFORMER INSTALLATIONS

Distribution System	Two-Phase—Two-Phase 2,300/115/230 Volt	Three-Phase—Two-Phase 2,300/3,984–115/230 Volt	Three-Phase—Three-Phase 2,300/3,984–115/199 Volt
Number of transformers per bank	2	2	3
Voltage rating of transformers	2,300–115/230	2,300/4,600–115/230*	2,300–115/230
150-kva. transformer bank			
Total investment	$1,096.00	$1,249.00	$1,353.00
Investment per kva.	7.31	8.33	9.02
Total annual cost per kva.†	1.30	1.46	1.54
75-kva. transformer bank			
Total investment	678.00	783.00	774.00
Investment per kva.	9.04	10.43	10.32
Total annual cost per kva.†	1.55	1.81	1.77
15-kva. transformer bank			
Total investment	286.00	339.00	337.00
Investment per kva.	19.07	22.60	22.47
Total annual cost per kva.†	3.10	3.74	3.62

* Transformers are the type rated at 2,300/4,600–115/230 volts with taps for 3,984 and 3,444 volts and will give full rated output when T-connected.

† Total annual cost includes fixed charges on investment and cost of losses evaluated on increment cost basis.

TABLE III—TOTAL ANNUAL COST OF NETWORK SYSTEMS EXCLUDING OPERATION AND MAINTENANCE

No.	Primary	Secondary	Substation	Feeders	Transformers	Mains	Total
		Range of Primary Voltages: 2,300–4,600 Volts					
1	2-ph. 3-wire 2,300/3,252-volt	4-ph. 5-wire 115,230-volt	$216,050	$92,900	$118,200	$108,760	$535,910
2	3-ph. 4-wire 2,300/3,984-volt	3-ph. 4-wire 133/230-volt	211,700	67,120	122,800	97,680	499,300
3	3-ph. 4-wire 2,300/3,984-volt	3-ph. 4-wire 115/199-volt	211,700	67,120	122,800	101,820	503,440
4	3-ph. 3-wire 300/3,984-volt	4-ph. 5-wire 115/230-volt	211,700	67,120	125,300	108,760	512,880
5	4-ph. 5-wire 2,300/4,600-volt	4-ph. 5-wire 115/230-volt	218,900	93,580	119,600	108,760	540,840
		13,200-Volt Primary					
1	3-ph. 3-wire 13,200-volt	3-ph. 4-wire 133/230-volt	122,900	44,100	147,900	97,680	412,580
2	3-ph. 3-wire 13,200-volt	3-ph. 4-wire 115/199-volt	122,900	44,100	147,900	101,820	416,720
3	3-ph. 3-wire 13,200-volt	4-ph. 5-wire 115/230-volt	122,900	44,100	153,800	108,760	429,560

three-phase, four-wire system must be either (*a*) two-wire 115-volt single-phase, or (*b*) three-wire 115/199 volt open "Y" or (*c*) three-phase, four-wire. Each of these solutions results in higher losses, poorer voltage regulation, unbalanced voltage, higher investment, singly or in combination. The two-phase, five-wire system requires none of these compromises or sacrifices.

In this comparison, consideration has not been given to the various other three-phase secondary systems which do not have some of the disadvantages of the three-phase "Y"—connected system. They have other combinations of disadvantages which are summarized in "Alternating-Current, Low-Voltage Networks," Serial Report of the N.E.L.A., Publication No. 25-1. (See abstract of this report in ELECTRICAL WORLD for June 20, 1925.)

TRANSFORMER INSTALLATIONS

For the purpose of this paper, the transformer installation for supplying the secondary mains from the primary distribution system is considered as a part of the secondary system. In considering the transformer installation, it is fully as important that attention be directed to the construction and cost elements of the supporting structure for the transformers if on a pole, or to the manhole or vault if the transformers are subway type.

For the two-phase, five-wire 115/230-volt secondary distribution system, the connections will be as shown in Figs. 2*a* and 2*b* for a two-phase primary and in Fig. 2*c* for a three-phase primary. In all of these combinations, for a given size bank, only two transformers, or a multiple of two, are required. For the three-phase, four-wire system, three transformers, or a multiple of three, are required. The use of polyphase transformer units is practicable for either two or three phase, but certain service and operating advantages are generally felt to be lost as compared with standard single-phase units.

There are marked advantages of having ordinarily two transformers per bank, with the two-phase system. On the aërial system, two units can be hung or arranged much more readily on a pole, with minimum decrease of working and climbing space for linemen. The mechanical advantages of a balanced transformer arrangement are apparent from Fig. 3. In the underground system, the use of two transformers is generally more economical of manhole space than the use of three transformers.

With two-phase primaries, standard transformers may be used in connection with the five-wire, two-phase secondary system. In the case of three-phase primaries, standard transformers with T taps are readily available at a slight increase in cost per unit.

The T connection and the combination of three-phase primaries with two-phase secondaries has some-

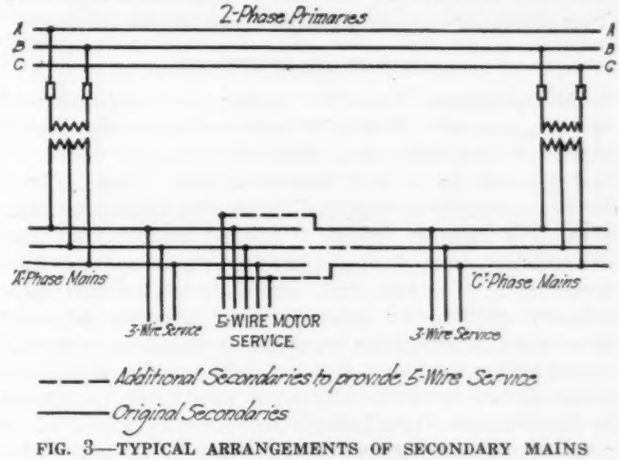


FIG. 3—TYPICAL ARRANGEMENTS OF SECONDARY MAINS ON CROSSARMS

times been referred to as a hybrid scheme. Let us reserve judgment on this matter and base our conclusions upon common-sense engineering, which must recognize construction, operating and cost facts in addition to purely theoretical considerations.

In the modern T-connected transformer bank, there is a voltage unbalance of the order of 1½ per cent and a phase displacement of 1½ deg. at 80 per cent power factor and much less at higher power factors. It can be readily shown that the per cent voltage unbalance caused by 100 amp. per wire in approximately 500 ft. of three-phase, 115/199-volt, four wire No. 2/0 secondaries on a crossarm with standard 14½-in. spacing is about the same as in a T-connected transformer bank having approximately 5 per cent impedance. There is no such inherent unbalance in two-phase, five-wire secondaries, when properly grouped, as the phases are separate and diametrically connected. The existence of current in the neutral will affect the voltage balance of the three-phase

TABLE IV—INVESTMENT FOR NETWORK SYSTEMS

No.	Primary	Secondary	Substation	Feeders	Transformers	Mains	Total
		Range of Primary Voltages: 2,300–4,600 Volts					
1	2-ph. 3-wire 2,300/3,252-volt	4-ph. 5-wire 115/230-volt	$1,695,000	$792,000	$773,000	$938,300	$4,198,300
2	3-ph. 4-wire 2,300/3,984-volt	3-ph. 4-wire 133/230-volt	1,665,900	584,000	790,000	851,700	3,891,600
3	3-ph. 4-wire 2,300/3,984-volt	3-ph. 4-wire 115/199-volt	1,665,900	584,000	790,000	880,700	3,920,600
4	3-ph., 3-wire 2,300/3,984-volt	4-ph. 4-wire 115/230-volt	1,665,900	584,000	830,000	938,300	4,018,200
5	4-ph. 5-wire 2,300/4,600-volt	4-ph. 5-wire 115/230-volt	1,728,600	816,000	783,000	938,300	4,265,900
		13,200-Volt Primary					
1	3-ph. 3-wire 13,200-volt	3-ph. 4-wire 133/230-volt	1,023,000	402,000	954,100	851,700	3,230,900
2	3-ph. 3-wire 13,200-volt	3-ph. 4-wire 115/199-volt	1,023,000	402,000	954,200	880,700	3,259,900
3	3-ph. 3-wire 13,200-volt	4-ph. 5-wire 115/230-volt	1,023,000	402,000	1,019,000	938,300	3,382,300

system more seriously than that of the two-phase system.

Typical arrangements of wires on a crossarm are shown in Fig. 3.

For an economic statement of the cost differentials between aërial transformer banks of the standard type connected (1) two-phase to two-phase, (2) three-phase to two-phase and (3) three-phase to three-phase, refer to Table II, which shows the comparative investments and annual cost (fixed charges and cost of losses) estimated on a comparative basis.

It will be noted that the costs for the two-phase to two-phase banks are distinctly less than for the other connections, and that the three-phase to two-phase and the three-phase to three-phase costs run very close.

The three-phase to two-phase transformer costs are based on a relatively costly unit with taps suitable for either a 4,000-volt or 4,600-volt primary, while the three-phase to three-phase transformer costs are based on the standard 2,300-volt unit. The three-phase to two-phase scheme therefore would allow a primary voltage of 4,600 with consequent appreciable primary feeder savings as compared with 4,000 volts.

It is therefore apparent that the two-phase, five-wire secondary system may be readily supplied economically from either two-phase or three-phase primaries.

GROWTH ADAPTABILITY

The two-phase, five-wire system, a combination of two single-phase, three-wire systems, possesses a high degree of flexibility and adaptability to all stages of load growth in a distribution system. Generally a district initially is supplied from single-phase, three-wire, 115/230-volt mains. As the district develops demands are made for polyphase supply to motors. This development is readily met, especially with a two-phase primary system, by extensions of existing adjacent three-wire, single-phase secondaries supplied from different primary phases, thus affording a five-wire, two-phase service with the minimum additional investment in transformer installations and secondary mains, as diagrammatically shown in Fig. 4. If the primaries are three-phase, and as the amount of motor load grows, the transformers will be erected in banks of two, and part of the secondary mains will become five-wire. A three-wire service from mains originally three-wire, when the mains are increased to five-wire, requires no change in the motor or to the customer's wiring. There is accordingly a large degree of growth flexibility with the two-phase system. This is also a result of the inherent high capacity per wire, of particular value with continuing growth of load where theoretical considerations often are completely outweighed by the necessity of providing reasonably for development.

With the three-phase, four-wire system, it is apparent that if a district is permitted to develop originally on a single-phase, three-wire basis, when it becomes necessary to provide for polyphase loads, the erection of two additional transformers will be necessary and also the conversion of the three-wire, single-phase secondary mains to four-wire, three-phase, unless such expedients as open "Y" three-wire distribution mains are taken into consideration.

In such a transition it will be necessary to care for every three-wire, 115/230-volt, single-phase customers' service in one of the following ways:

1. *Change to Four-Wire, Three-Phase.* This requires running an additional wire, replacement of the single-phase meter by a polyphase meter, and changing the customers' wiring for a four-wire service.

2. *Change to Two-Wire, 115-Volt, Single-Phase.* This may require larger service wires, and a change to a two-wire meter. In many situations, as with electric range loads, such a change would greatly increase the voltage drop or necessitate a separate service to maintain the proper voltage on lamps.

3. *Change to Three-Wire, Three-Phase 115/199-Volt Open-"Y."* This will require a second meter or replacement of three-wire meters by polyphase metering. The service voltage will be unbalanced by the current in the neutral and the losses will be much higher in the service wires and the main neutral.

If the mains are made four-wire initially, there is the initial extra investment in transformers and mains, and the unavoidable choice must be made between the above three types of services, each with its disadvantages as compared with the three-wire, 115/230-volt service. The importance of this situation is apparent from the relatively large proportion of services which are single-phase on most systems.

Although this paper deals particularly with secondary distribution, there are a number of related points in connection with primary distribution that should be borne in mind.

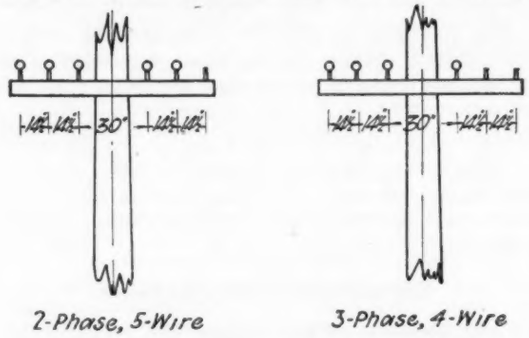


FIG. 4—TYPICAL METHOD OF DEVELOPMENT FOR TWO-PHASE, FIVE-WIRE SYSTEM

Primary distribution is affected by a large number of variable elements, including the size and spacing of substations, length and capacity of feeders, density and character of load, both primary and secondary, type of system, radial, parallel, loop, network feed, aërial, underground, etc., configuration of streets, tree conditions, governmental restrictions relating to voltage, aërial construction, tree trimming, etc., and contractual restrictions such as those relating to voltage, type of construction, etc., in joint pole use.

Again, as in the case of secondary distribution, the influence of local conditions upon the type of system is very great and it is often difficult to make comparisons between systems in different localities.

It is desired in connection with primary distribution to call attention to one factor which in recent years has become of increasing importance in this involved problem. Pressure of increasing load demands by the public and the desire for greater economies by central-station engineers in the use of copper and the saving of losses have of late greatly accelerated the increase from 2,300 volts to 4,000 volts, to 6,600 volts and 11,000 volts, and to 13,200 volts and 22,000 volts. The economies have resulted, not particularly from any change in the number of phases as such, but from the higher voltage. This voltage increase has progressed in a way undreamed of twenty, or even ten years ago.

In the two-phase, five-wire system, single-phase

service loops generally are two-wire for loads up to a prescribed figure and three-wire for loads in excess. For the former range of loads, which are representative of small residential consumers, the metering is identical whether from a two-phase system or a three-phase system. For the latter range of loads the metering costs involve a comparison between a three-wire, single-phase meter for the two-phase system and polyphase metering or raising the limit for two-wire services for the three-phase system. The cost of a three-wire, single-phase meter installation is slightly lower than the cost of a two-wire single-phase meter installation of the same kilovolt-ampere capacity and is very much less than any type of polyphase metering now in use.

METERING CUSTOMERS' INSTALLATIONS

For metering polyphase power load, there is practically no difference in the meter costs for two-phase or three-phase.

A study of metering costs for a typical system including all types of metering indicates that the total investment in metering equipment would be about 15 per cent greater for the three-phase system.

The cost of two-phase motors of the usual voltage and speed ratings is identical with that of three-phase motors. In some cases there is a slight additional cost for the starting compensators for two-phase motors. The two-phase motor at rated full load has an efficiency slightly less than the three-phase motor, for the usual voltage and speed ratings, which is of the order of 1 per cent for sizes up to about 25 hp. and less for larger sizes. This difference is due partly to the slightly less efficient coil design for two-phase and partly to the fact that most manufacturers design parts which are interchangeable for two-phase and three-phase motors but which are not always quite the most efficient design for two-phase motors. The torque characteristics of the two-phase motor are as good as, if not better than, the three-phase motor, according to manufacturer's rating sheets. The effect of reduced voltage under some of the three-phase, four-wire schemes is to decrease materially the pull-out torque of the standard 220-volt motor.

The two-phase, five-wire system uses standard motors of standard 220-volt rating, while the three-phase, four-wire system with 115/199-volt mains require the development of a new line of 199-volt motors or the material derating of the present line of motors (unless auto-transformers are resorted to).

For lighting loads there are difficulties with the three-phase, four-wire system which do not exist with the two-phase, five-wire system. The main feeds to panel boards must be either four-wire, 115/199-volt, with a more expensive four-wire panel board, or they must be three-wire open "Y" with the losses in the wiring approximately 50 per cent higher than with three-wire, single-phase feeds. There will also be a voltage unbalance due to the asymmetrical phase relations of the current in the wires, its magnitude depending upon the power factor, and an increased voltage drop. Single-phase, three-wire feeds from a two-phase, five-wire system do not have these disadvantages.

GENERAL ECONOMIC FEATURES

It has been seen from the foregoing that the character of service from the two-phase, five-wire secondary system, so far as it meets the various distribution, engineering and customers' requirements, has no serious disadvantages as compared with the three-phase system, and in many respects has outstanding advantages.

Therefore, under such conditions, it will be of interest to compare the over-all economies of the two systems, in order to determine the probable magnitude of the cost differential and the importance of this factor as compared with costs of change-over and other factors not readily measured in dollars.

For this measurement of their relative inherent economic standing, an analysis of several combinations of underground primary and secondary distribution systems with two-phase and three-phase secondaries, was made on a comparative basis, as applied to a definite load and area. Each type of system was given the full benefit of its most economical design. Tables III and IV summarize the results of this investigation.

The cost of the mains for the different types of secondary systems does not vary widely, being of the order of magnitude of 10 per cent for the total annual main cost and for the investment in mains. For the transformers and mains together, the cost variation is even smaller in either the 2,300-volt to 4,600-volt primary range or with 13,200-volt primary. It will also be noted that the investment in mains is only about 20 per cent of the total plant investment in substations, feeders, transformers and secondary mains. The tables also indicate that the part of the problem demanding further engineering attention is that pertaining to the primary, where higher voltages than 4,600 show marked possible economies.

These analyses, although on a comparable basis, cannot evaluate in dollars many of the advantages of the two-phase, five-wire secondary system, which it is felt fairly match or outweigh the advantages of the three-phase, four-wire system for a densely loaded underground district.

Other figures which have been prepared lead to the same conclusions for the aërial system.

In the change-over of a direct-current network system to alternating current, it may be possible in the choice of the best alternating-current system to consider the particular district as a separate problem, because the direct-current equipment will require replacement in any event. However, existing alternating-current areas, both aërial and underground, which eventually will form part of the network area, and the need for standardization on one universal type of system will have a necessarily large, if not a predominating, influence on the decision.

CONCLUSION

With an existing alternating-current system of any type, now rendering adequate service satisfactory to the consumers, and economical and adaptable to growth, the cost of change-over to any other system becomes a very important factor. In addition to those costs of a fairly determinable nature, there are others less susceptible of accurate prediction, such as the extra cost of operating two types of systems during the change-over and the effect of a longer or shorter change-over period.

Accordingly, with a relatively small inherent cost differential between the existing system and one having certain more or less proved advantages and some known disadvantages, the central-station engineer must have extremely strong arguments leading out of his local situation in order to justify a change from the existing system.

Central-Station Lighting and Power Customers, Showing Growth During 1923 and 1924

State	Total Domestic Lighting Customers				Total Commercial Lighting Customers				Total Industrial Power Customers				Total Central-Station Customers of All Kinds			
	Jan. 1, 1923	Jan. 1, 1924	Jan. 1, 1925	New Customers Added During 1924	Jan. 1 1923	Jan. 1, 1924	Jan. 1, 1925	New Customers Added During 1924	Jan. 1, 1923	Jan. 1, 1924	Jan. 1, 1925	New Customers Added During 1924	Jan. 1, 1923	Jan. 1, 1924	Jan. 1, 1925	New Customers Added During 1924
United States	9,925,210	11,623,644	13,406,777	1,782,539	1,954,450	2,261,347	2,588,983	327,636	455,060	502,736	570,844	68,108	12,334,720	14,377,431	16,555,714	2,178,283
New England	879,060	1,035,520	1,207,530	152,010	189,900	222,890	244,320	21,430	40,400	45,307	49,282	3,975	1,109,360	1,323,717	1,501,132	177,415
Middle Atlantic	2,160,540	2,571,530	3,096,802	525,272	487,200	544,039	669,168	125,129	88,960	93,608	106,902	13,294	2,736,700	3,209,177	3,872,872	663,695
South Atlantic	626,820	748,450	894,902	146,452	142,380	164,735	190,368	25,633	27,890	33,770	39,575	5,805	797,090	946,955	1,124,845	177,890
East North Central	2,761,840	3,183,140	3,535,823	352,089	483,060	556,424	612,063	55,639	108,500	114,319	123,872	9,553	3,353,400	3,843,587	4,260,868	417,281
West North Central	1,134,090	1,290,837	1,475,953	185,116	215,950	253,746	279,438	25,692	50,170	53,668	63,250	5,982	1,400,210	1,598,251	1,818,641	220,390
East South Central	294,820	378,137	453,782	75,645	55,250	76,259	89,657	13,398	13,450	20,121	22,917	2,796	363,520	474,517	566,356	91,839
West South Central	630,920	722,520	814,118	91,598	100,740	126,135	142,863	16,728	24,610	29,037	34,362	5,325	756,270	877,692	991,343	113,651
Mountain	378,200	411,250	449,872	38,622	59,440	63,645	69,422	5,777	17,900	17,420	20,784	3,356	455,540	492,323	540,078	47,755
Pacific	1,058,920	1,262,260	1,477,995	215,735	220,530	253,474	291,684	38,210	83,180	95,178	107,900	14,422	1,362,630	1,611,212	1,879,579	268,367
New England																
Maine	101,840	115,710	140,480	24,770	23,420	30,940	33,280	2,340	4,740	5,508	6,726	1,218	130,000	152,158	180,486	28,328
New Hampshire	42,450	46,190	57,420	11,230	9,820	10,410	12,930	2,520	2,610	2,950	3,159	299	54,880	59,460	73,509	14,049
Vermont	47,950	50,870	55,310	4,440	8,620	11,210	12,260	1,050	2,170	2,418	2,767	349	58,740	64,498	70,337	5,839
Massachusetts	455,560	550,490	628,030	77,540	102,960	113,540	125,060	11,520	17,970	21,583	23,234	1,651	576,490	685,613	776,324	90,711
Rhode Island	57,730	72,290	86,030	13,740	15,690	16,860	18,090	1,230	3,170	3,335	3,482	147	76,590	92,485	107,602	15,117
Connecticut	173,530	219,970	240,260	20,290	29,390	39,930	42,700	2,770	9,740	9,603	9,914	311	212,660	269,503	292,874	23,371
Middle Atlantic																
New York	1,051,970	1,183,130	1,411,760	228,630	264,130	289,870	373,603	83,733	40,110	43,461	51,865	8,404	1,356,210	1,516,461	1,837,228	320,767
New Jersey	376,270	446,390	563,160	116,770	74,320	84,530	107,180	22,650	17,570	16,419	19,914	3,495	468,160	547,339	690,254	142,915
Pennsylvania	732,300	942,010	1,121,882	179,872	148,750	169,636	188,385	18,746	31,280	33,728	35,123	1,395	912,330	1,145,377	1,345,390	200,013
South Atlantic																
Delaware	17,780	19,624	21,112	1,488	5,380	5,551	5,602	51	730	713	776	63	23,893	25,888	27,490	1,602
Maryland	111,290	123,900	163,060	39,160	22,480	23,129	27,270	4,141	3,360	3,823	4,205	382	137,130	150,852	194,535	43,683
District of Columbia	39,840	42,920	59,000	16,080	13,630	16,410	19,400	2,990	310	2,500	2,665	165	53,780	61,830	81,065	19,235
Virginia	84,420	105,210	118,050	12,840	8,620	12,050	15,474	3,424	6,260	7,071	7,910	839	99,300	124,331	141,434	17,103
West Virginia	60,790	71,430	88,530	17,100	14,060	16,850	20,126	3,276	2,730	2,998	4,058	1,060	77,580	91,278	112,714	21,436
North Carolina	80,860	99,306	127,170	27,864	23,710	27,620	31,364	3,744	4,290	5,098	6,793	1,695	108,860	132,024	165,327	33,303
South Carolina	51,900	59,690	68,660	8,970	12,520	15,070	16,316	1,246	1,760	2,455	2,804	349	66,180	77,215	87,780	10,565
Georgia	96,480	117,570	127,234	9,664	23,170	25,675	27,150	1,475	5,600	5,842	6,319	477	125,250	149,087	160,703	11,616
Florida	83,460	108,800	122,086	13,286	18,810	22,380	27,666	5,286	2,850	3,270	4,045	775	105,120	134,450	153,797	19,347
East North Central																
Ohio	727,160	825,288	910,423	85,135	109,790	124,948	141,220	16,272	21,920	22,667	23,265	598	858,870	972,903	1,074,908	102,005
Indiana	324,210	367,260	405,785	38,525	53,670	60,060	62,085	2,025	21,260	16,233	17,958	1,725	399,140	443,553	485,828	42,275
Illinois	1,001,060	1,112,250	1,220,390	107,546	184,600	211,550	231,314	19,764	30,230	36,110	39,773	3,663	1,215,890	1,349,614	1,480,587	130,973
Michigan	478,140	596,362	663,121	66,759	84,100	99,816	108,514	8,698	20,130	21,696	23,396	1,700	582,370	717,874	795,031	77,157
Wisconsin	231,270	281,980	336,104	54,124	50,900	68,050	68,930	8,860	14,960	17,613	19,480	1,867	297,130	359,643	424,514	64,871
West North Central																
Minnesota	292,790	319,840	370,838	50,998	56,250	59,070	63,099	4,029	12,920	13,989	16,613	2,624	301,960	392,899	450,550	57,651
Iowa	198,200	231,550	264,564	33,014	44,490	48,270	54,371	6,101	9,480	11,263	13,732	2,469	252,170	291,083	332,667	41,584
Missouri	306,210	354,660	397,410	42,750	57,803	77,060	83,113	6,053	13,100	11,787	13,116	1,329	377,110	443,507	493,639	50,132
North Dakota	19,120	26,385	32,210	5,825	3,510	5,826	7,373	1,547	1,320	1,239	1,578	339	23,950	33,450	41,161	7,711
South Dakota	34,990	41,080	47,194	6,114	6,310	8,260	10,202	1,942	2,220	2,753	3,624	871	43,520	52,093	61,020	8,927
Nebraska	101,240	118,417	130,650	12,233	17,680	21,340	22,635	1,295	4,620	5,519	6,455	936	123,540	145,276	159,740	14,464
Kansas	181,540	198,905	233,087	34,182	29,910	33,920	38,645	4,725	6,510	7,118	8,132	1,014	217,960	239,943	279,864	39,921
East South Central																
Kentucky	87,690	122,137	150,702	28,565	17,780	28,408	32,086	3,678	4,510	7,057	7,969	912	109,980	157,602	190,757	33,155
Tennessee	93,550	125,390	160,030	34,640	16,660	23,910	28,803	4,893	4,260	6,917	8,293	1,376	114,470	156,217	197,126	40,909
Alabama	80,810	91,620	99,930	8,310	14,190	15,391	19,390	3,999	3,010	4,103	4,436	333	98,010	111,114	123,756	12,642
Mississippi	32,770	38,990	43,120	4,130	6,620	8,550	9,378	828	1,670	2,044	2,219	175	41,060	49,584	54,717	5,133
West South Central																
Arkansas	74,530	82,500	88,790	6,290	14,080	15,220	16,270	1,050	2,260	2,534	3,121	587	90,870	100,254	108,181	7,927
Louisiana	71,880	84,510	94,860	10,350	16,920	21,045	22,598	1,553	3,360	4,320	4,865	545	92,160	109,875	122,323	124,448
Oklahoma	121,130	144,690	172,158	27,468	18,760	25,280	28,122	2,842	9,120	7,891	9,387	1,496	149,010	177,861	209,667	31,806
Texas	363,380	410,820	458,310	47,490	50,980	64,590	75,873	11,283	9,870	14,292	16,989	2,697	424,230	489,702	551,172	61,470
Mountain																
Montana	49,610	54,820	60,731	5,911	10,250	10,865	11,976	1,111	4,720	2,805	3,297	492	64,580	68,490	76,004	7,514
Idaho	43,020	45,040	48,321	3,281	10,110	10,300	11,203	903	1,570	1,788	1,887	99	54,700	57,128	61,411	4,283
Wyoming	23,700	26,010	27,290	1,280	3,350	3,080	3,331	251	860	1,047	1,265	218	27,910	30,137	31,886	1,749
Colorado	125,530	133,190	146,670	13,480	17,360	19,820	21,900	2,080	6,420	6,779	8,140	1,361	149,310	159,789	176,710	16,921
New Mexico	16,830	18,100	19,550	1,450	2,900	3,110	3,334	224	650	817	942	125	20,380	22,027	23,826	1,799
Arizona	20,610	25,670	29,090	3,420	3,160	4,460	4,775	315	1,280	1,455	1,776	321	25,050	31,585	35,641	4,056
Utah	85,470	96,240	104,630	8,390	9,860	10,160	10,774	614	1,940	2,252	2,935	683	97,270	108,652	118,339	9,687
Nevada	13,430	12,180	13,590	1,410	2,450	1,850	2,129	279	468	485	542	57	16,340	14,515	16,261	1,746
Pacific																
Washington	209,390	233,530	248,160	14,630	33,130	36,164	41,981	5,817	10,810	11,886	13,954	2,068	253,330	281,580	304,095	22,515
Oregon	103,310	126,050	137,943	11,893	18,460	20,250	22,063	1,813	6,830	6,906	7,739	833	128,600	153,206	167,745	14,539
California	746,220	902,680	1,091,892	189,212	168,940	197,060	227,640	38,210	65,540	76,686	88,207	11,521	980,700	1,176,426	1,407,739	231,313

More Than Two Million New Customers in 1924

STUDENTS of the electric light and power industry are intensely interested in its growth and the trends that it is likely to follow. A survey just completed by the ELECTRICAL WORLD to ascertain the number of customers added to the central-station lines in 1924 gives much food for thought, especially to those who have expressed the feeling that the industry has reached its peak of growth and who expected the annual increment of growth to decrease after 1923. This survey indicates that 2,178,283 new customers of all classes were added to the service lines of the central stations during 1924. These figures are based upon 2,341 estimates made by central-station managers, the estimates being submitted by counties, and are believed to picture the growth of the industry during 1924 with a fair degree of accuracy.

On January 1, 1925, there were in all 13,395,887 domestic lighting customers in the country, as against 9,925,210 on January 1, 1923, and 11,613,348 on January 1, 1924. The survey indicates that during 1924 1,782,539 new domestic lighting customers were added to the industry's service lines. This is the largest increase ever recorded in any one year. The Middle Atlantic States reported the largest increase in new domestic customers, with 525,272, followed by the East North Central States, with 352,089 new customers of this class. The State of New York reported 228,630 new domestic customers added during the year, followed by California, with 189,212 new domestic customers.

A total of 327,636 new commercial lighting customers was added during 1924, making 2,588,983 customers of this class on January 1, 1925. As was to be expected, the greatest growth in number of customers of this type is to be found in the sections of the country which contain the largest cities.

A total of 570,844 industrial power customers was reported on January 1, 1925, indicating a growth of 68,108 during 1924.

Letters from Our Readers

The St. John Development and the Canadian Export Tax on Power

To the Editor of the ELECTRICAL WORLD:

The International Joint Commission, while authorizing the New Brunswisk Hydro-Electric Commission, an organ of the government of that province, to proceed with the development of 75,000 hp. at the Grand Falls on the St. John River, adroitly avoided a ruling on two controversial questions brought before it—what principle should govern the division of power on an international waterway and whether the Dominion government has the right to levy a tax upon power exported to the United States from a development in New Brunswick dependent upon an international waterway.

From the initial development at Grand Falls New Brunswick has agreed that 2,000 hp. shall be made available in the United States at the same rates as shall be charged users in New Brunswick. This means that the New Brunswick government is prepared either to absorb the tax which the Dominion government now imposes on the export of power from Canada or to challenge the constitutional right of the Dominion to impose such a tax—a question about which leading legal lights are known to differ. The United States claimed that as a right it was entitled to 1,600 continuous horsepower from the initial development, less than New Brunswick has undertaken shall be delivered over the border if and when required.

At the recent two days' session of the International Joint Commission it was evident that counsel for Maine and New Brunswick were more in harmony than counsel for Washington and Ottawa. So the question is being asked whether New Brunswick, if it did not have hopes of successfully challenging the Dominion export tax, would have voluntarily agreed to export to Maine at New Brunswick prices more power than the United States claimed as a right.

C. MCKAY.
Montreal, Canada.

Sectional Committee for Electrical Safety Code Parts 2 and 4

To the Editor of the ELECTRICAL WORLD:

On page 1388 of the June 27 issue of the ELECTRICAL WORLD appears a statement regarding the revision of the National Electrical Safety Code which may have been a correct statement at the time it was written but has been made obsolete by more recent developments.

At a meeting of the Sectional Committee which has been carrying out the revision of Part 2 of the code, held on March 5 and 6, these recommendations were considered and were in part adopted and in part rejected. Their publication at this time may be of historical interest, but the industry should be cautioned against the assumption that this statement represents material which will be included in the next edition of the Electrical Safety Code or that it represents any present proposal for any such inclusion.

It may be stated, however, for the information of your readers that Tables I and III were accepted and that Table II with the exception of item 2 was rejected.

ROY C. DWYER,
Washington, D. C. Secretary Sectional Committee.

Taping Substation Buses

To the Editor of the ELECTRICAL WORLD:

I noted with interest an article in the March 7 issue of the ELECTRICAL WORLD, page 517, stating that all interior substation buses of the Utica Gas & Electric Company are taped to prevent accidents such as might be caused by coming in contact with live parts for the short-circuiting of phases. The writer commenced this practice in 1902 with 2,300-volt buses and has consistently followed it ever since. Previous to adopting it, I was never able to look upon uninsulated 2,300-volt buses, mounted closely together, without a shudder and since adopting it I have often wondered why others do not do likewise.

I know that our practice in this respect has prevented serious shutdowns as well as accidents to individuals. All buses not protected by cell work or similar structures should be sufficiently taped to insulate them against the voltage on which they are used. We have followed this practice on all 2,300-volt buses and on intermediate voltages up to and including 13,000 and have in some instances used it on 55,000 volts.

E. C. LINDSAY,
Puget Sound Power & Light Company, Seattle, Wash. Engineer Central District.

Central Station and Industrial Practice

Transformer Cooling System

BY R. M. PEABODY
Engineer Southern California Edison Company, Los Angeles, Cal.

IN TRYING to develop a cooling system which would eliminate the necessity of using water at all for cooling and at the same time keep the cost down below that of the self-cooled transformers in the large sizes, the Southern California Edison Company has within the past year made some trials of circulating the transformer oil through automobile-type radiators and cooling them with the air.

As a preliminary study and to determine the rate of heat transfer which could be expected, a small experimental system was built, consisting of five nine-square radiators so arranged that transformer oil could be circulated through them either in series or in parallel at varying velocities and that air for cooling could be blown over them at varying rates. The oil was heated by means of electric heaters and arrangements were made to measure accurately the amount of oil circulated, the air velocity and the oil and air temperatures. The results of this test showed that a ratio of heat transfer, based on the radiator surface in contact with the oil, of from 5 to 25 B.t.u. per square foot per hour per degree was easily obtainable. The higher rates of heat transfer were for the higher air and oil velocities. The tests showed conclusively that the rate of heat transfer increased markedly in proportion to the velocity of the oil through the radiators, and also with the velocity of the air over the radiators, but the effect of varying the air velocity was much less than that of varying the oil velocity. The general layout of the apparatus used in this test is shown in Fig. 3.

Estimates based on the results of these tests were favorable enough for the company to go ahead with the installation of an automobile-type radiator system for a bank of three 5,000-kva. transformers. In designing this system it was found that if a high air velocity was used, it would require an excessive amount of power for the blower, owing to the high resistance of the radiators. The arrangement finally decided on and built is shown in Fig. 2. Fig. 1 shows the details of the radiators, which are six in number, each 20 in. wide and 10 ft. 4 in. long. The radiators are of special construction to withstand the internal oil pressure, although they follow a standard automobile radiator design. The radiators are arranged in a horizontal plane and so piped that the oil can be pumped through any or all of the radiators in series or in parallel, or in any combination of series and parallel, in order to find the most efficient oil velocity. The radiators are placed about 6 ft. above the ground in a sheet-metal stack about 30 ft. high. Below the radiators there are doors on three sides of the stack to admit air, which is drawn up through the stack by natural draft induced by the heat of the oil in the radiators. On the fourth side of the stack, below the radiators, there is a connection to a fan, which can be used when the natural-draft doors are closed to give a higher air velocity in very warm weather or in case of a continued overload on the transformers.

This apparatus was placed in service in March of this year and has been operating about four months. The radiators so far have been absolutely oil-tight, and the only trouble experienced has been some slight leaks at the ends of the radiators due to insufficient provision for expansion. This defect has been remedied and can easily be taken care of in future installations.

No complete tests have been made as yet to determine accurately the rate of heat transfer and its variation with oil and air velocity, but sufficient temperature observations have been made to show definitely that the apparatus as installed, and using only natural draft, will hold the transformer temperature rise down to about 40 deg. C. when the air temperature is about 27 deg. C. The corresponding rate of heat transfer is from 5 to 8 B.t.u. per square foot per hour per degree F., with an oil velocity in the radiators of about 1 ft. per second and an air

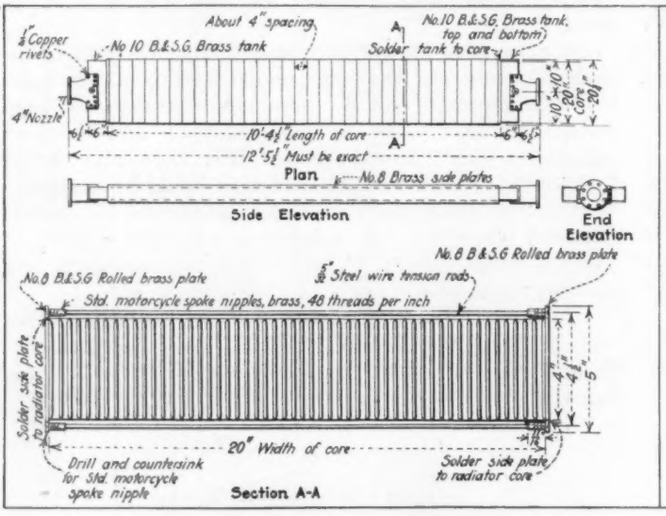

About 4" spacing
No.10 B.&S.G. Brass tank, top and bottom
Solder tank to core
No. 10 B.&S.G. Brass tank
4" Copper rivets
4" Nozzle
10'-4½" Length of core
12'-5½" Must be exact
Plan
No.8 Brass side plates
Side Elevation
End Elevation
No.8 B.&S.G. Rolled brass plate
No.8 B.&S.G. Rolled brass plate
⅜" Steel wire tension rods
Std. motorcycle spoke nipples, brass, 48 threads per inch
Solder side plate to radiator core
20" Width of core
Drill and countersink for Std. motorcycle spoke nipple
Solder side plate to radiator core
Section A-A

FIG. 1—DESIGN OF RADIATORS

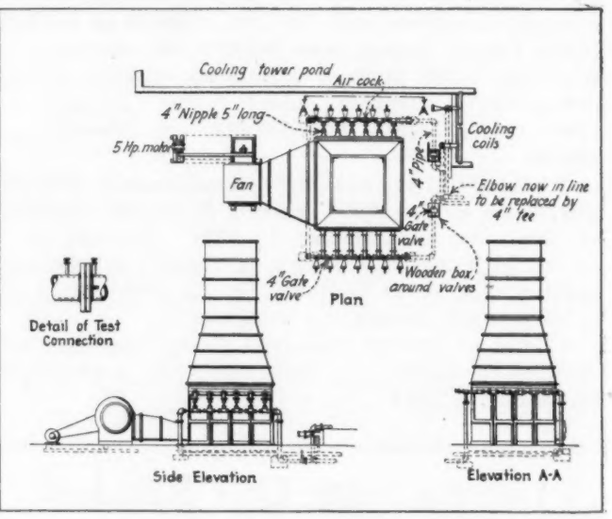


FIG. 2—LAYOUT OF COOLING SYSTEM

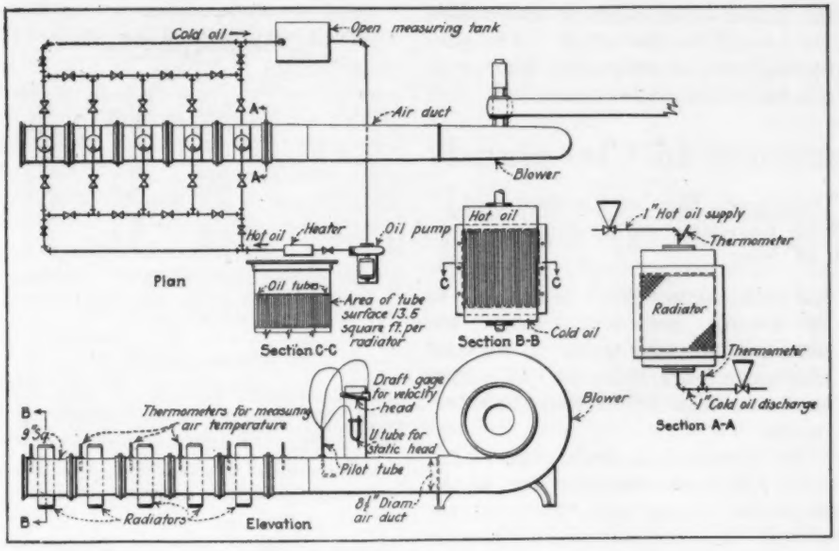


FIG. 3—LAYOUT OF TEST SET

velocity in the stack of about 220 ft. per minute.

The radiators will be kept in continuous service for several months. One point in particular which will be watched for is to see whether or not there will be any sludging of the oil in the small radiator passages.

The annual cost of this installation, assuming that the blower has to run one-fourth of the time, is a trifle less than for a water-cooled installation of the same capacity where the water would have to be treated. No estimates have been worked out for smaller capacities.

The advantage of such a radiator cooling system, aside from its low cost, is that it does away entirely with the trouble of treating or handling cooling water for the transformers.

Electric Heating Used to Replace Steam

BY L. V. CURRAN
Superintendent of Power,
Tennessee Copper Company

THE PLANT of the Tennessee Copper Company covers about forty acres. Scattered about this space are many isolated tanks and buildings that need heat. The company recently realized that by using steam for heating these isolated places, it was heating up almost the whole outdoors. In order to reduce these losses, it decided on some extensive changes in its equipment. The first step was the grouping, as far as possible, of the shop offices, operators' shacks, etc. They were then equipped with electric heaters. We found that a heater taking approximately 1,200 watts will keep a shed 5 ft. x 4 ft. x 7 ft. high comfortable when the outside air is about 10 deg. F. The heaters are convenient, easy to install, dependable and there is no danger of their starting a fire.

In the laboratory, steam hot plates were replaced by electric hot plates. The steam coils in the water still were replaced by bayonet heaters, and those of the sample drier were taken out, and electric steel-clad heaters substituted. In hospitals, also, we turned to this clean, safe form of heat. The sterilizer steam coil was removed, and a bayonet heater substituted, and a disk heater is now used to heat the instrument sterilizer. In both the laboratory and the hospital, we found that in addition to being clean and safe, electric heat is convenient and dependable.

The carpenter shop was provided with an electric glue pot, which soon proved its value. Two oil storages are provided with electric heaters for use in cold weather. Because of its large size and its proximity to the boiler house, the change house is still heated by steam, but the hot water system is provided with bayonet heaters for use in summer.

It has been found that these electric heaters are saving the company money, because under the old system the long steam lines were expensive to put up, maintenance costs were high, and losses in the lines and traps were so great that the useful heat was but a small fraction of the losses. With the electrical installation the energy is utilized efficiently, maintenance costs are negligible and the company is getting heat when it wants it, where it wants it and as it wants it.

Erecting 45 Poles per Day with Eight Men

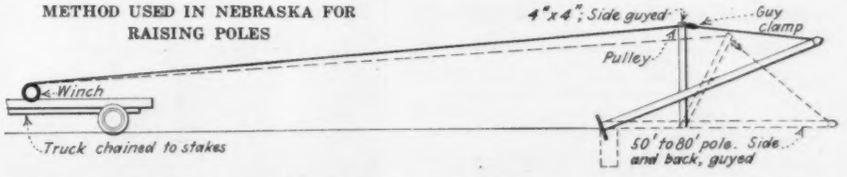
BY B. E. ELLSWORTH
Construction Department, Nebraska Gas & Electric Company, Lincoln, Neb.

NO ELABORATE hoists or braces are required to raise large poles by this method, and the simplicity of the equipment adds greatly to the speed of transportation. Eighty-foot poles are raised almost as easily as fifties. The equipment is cheap and easily built. "A" frames may be raised as a unit, but it has been found best, if the poles are longer than 55 ft., to erect them one at a time. Single poles may be raised with or without cross-arms.

The only equipment necessary is a winch, one 4 in. x 4 in. beam (20 ft. to 30 ft. long depending upon the height of pole to be raised) and five ropes for guying. For extremely long poles a 6 in. x 6 in. beam may have to be used. The accompanying sketch shows clearly the method used.

The truck containing the winch is anchored with chains to two stakes. For small poles, blocks of wood placed under the wheels will suffice. The beam is erected about 25 ft. from the pole butt and leaning at a considerable angle toward the top of the pole. This beam must be of good grain wood and have a pulley near the top against which the winch line rolls when sliding toward the truck. The line is clamped to the pole top and a clamp is also placed directly behind the beam to prevent the plank from falling forward.

METHOD USED IN NEBRASKA FOR RAISING POLES



The beam and pole have two side guy ropes each and the pole has one back guy rope. One man is employed at the butt board, five at the guys, one truck man and one foreman.

When a horizontal pull is applied by the winch, an upward pull is

exerted on the top of the pole; as the pole raises the beam becomes vertical, leans toward the truck and finally rolls along the cable toward the truck after the pole has raised far enough to liberate it. The pole by this time is sufficiently high so it can be raised with ease.

Powdered Fuel Experience in Cleveland

Considers Pulverizer Mills, Fuel Transport, Burner Feeders and Construction, Furnace Wall Construction and Prevention of Slag

THE powdered fuel boilers at the Lake Shore station of the Cleveland Electric Illuminating Company, the furnace construction and fuel-preparation equipment have been in operation for a long enough period so that the experience therewith is enlightening regarding what can be expected with modern pulverized fuel furnaces in electric utility operation. Distinguishing it from some of the earlier installations of powdered fuel equipment, this plant does not dry the coal before or after pulverizing, because it contains only 2 per cent to 8 per cent moisture, with an average of 3 per cent or 4 per cent, although provision is made for waste-heat driers if they ever became necessary.

Experience with the 6-ton, six-roll Raymond mills, used for pulverizing the coal, has been very satisfactory, they being relatively quiet (a measure of vibration and consequent wear) and the maintenance not being high. The mills stand up very well, the parts showing the greatest number of replacements being the exhaust fans, which can, however, be replaced readily in an hour. Since larger capacity mills could be operated with no increase in attendance, it is possible that the experience with a fifteen-ton mill of the same make in the heating plant of the Cleveland Electric Illuminating Company may lead to use of larger mills in the future. The data collected so far indicate that the amount of energy required to operate the mills ranges from 18 kw.-hr. to 22 kw.-hr. per ton. From the progress already made it appears that some more study of mill operation will lead to further improvements.

No trouble has been experienced with fuel lines clogging due to the moisture of the coal, provided air around the conveyors and cyclones is kept at about 70 deg. F. This experience applies to the screw feed of the coal and may not hold for other methods.

On each end of each furnace are eight burners, which are supplied with coal by separate feeders, having individual drive motors of 1.5 hp. each to give flexibility of control. Even with clutch arrangements that are available, it is not believed by the company that sufficient flexibility is obtained with group drives, but an opportunity surely exists for a manufacturer to develop some mechanical transmission that will enable sufficient flexibility with group drives and thus enable users to economize in the motor investments needed for such an installation.

The burners, which are of the corrugated fan-tail type, are inclined at about 10 deg. from the vertical to direct the powdered fuel into the furnaces effectively. Because of the more effective spreading of the coal obtained with corrugated fan-tail burners, they are preferred because they give a shorter flame. While it was previously stated that no trouble had been experienced with moist coal, it is possible that the occasional flickers at the burners are due to slugs of moist coal. Further study of burners and methods of more effectively spreading the coal at the burner tips may result in valuable information that will help to shorten flame travel and thereby cut down the cost of furnaces, which now constitutes one of the biggest investments and sources of expense in powdered fuel plants. As emphasized by the various authorities in the past, however, it is imperative to prevent local concentration of heat and flame impingement directly on furnace walls to minimize the erosion thereof caused by the heat.

Each boiler contains 30,600 sq.ft. of heating surface, 4,520 sq.ft. of superheater surface, 835 sq.ft. of water screen surface, 22,080 sq.ft. of economizer surface and 26,000 cu.ft. of furnace volume above the water screen over the ash pits. The furnace walls are cooled and the combustion air preheated by circulating it through the channels back of furnace

SOFTENING AND MELTING TEMPERATURES OF FURNACE BRICK, MORTAR AND COAL ASH

	Softening Point Deg. F.	Melting Point, Deg. F.
Plaster coating	2,598	2,640
Brick	2,585	2,650
Coal ash	2,016	2,147

CHARACTERISTICS OF MOTORS DRIVING FULL EQUIPMENT

Voltage	Current	Hp.	R.P.M.	To Drive
220	Direct cur.	1.5	500–1,500	Feeders
2,200	Altern. cur.	100	1,200	Blowers
440	Altern. cur.	15	900	Conveyors
2,200	Altern. cur.	100	450	Mills
2,200	Altern. cur.	50	1,200	Mill exhausters
2,200	Altern. cur.	150	120–360	Induced draft

Steel Pole Construction

The steel pole line construction used by the Great Western Power Company near Sacramento, Cal., is shown above. The poles are of the latticed type, 70 ft. in height, and carry a 22-kv. circuit. Ample clearance over shade trees is afforded with spans averaging 400 ft.

MONTHLY EFFICIENCIES OF LAKE SHORE STATION (CLEVELAND)

Month	Year	Efficiency, Gross	Per Cent Net
July	1924	87.8	85.9
August	1924	90.1	88.2
September	1924	90.4	88.3
October	1924	88.4	86.8
November	1924	90.0	88.2
December	1924	89.4	87.4
January	1925	90.9	88.9
February	1925	90.0	88.2
March	1925	88.8	86.8

ANALYISIS OF COAL USED IN LAKE SHORE STATION

Proximate Analysis	
B.t.u.	12,629
Moisture, per cent	2.3
Volatile, per cent	35.4
Fixed carbon, per cent	51.2
Ash, per cent	11.1
	100.0
Ultimate Analysis	
Moisture, per cent	2.3
Carbon, per cent	68.9
Hydrogen, per cent	4.8
Nitrogen, per cent	1.1
Oxygen, per cent	8.1
Ash, per cent	11.1
Sulphur, per cent	3.7
	100.0

walls, which are 9 in. thick, backed by ventilating space. In laying up the brick a ½ in. spacer is left between each third brick and later withdrawn to allow for expansion of the bricks. Incidentally, the air entering the furnace through these spaces helps to cool the bricks, but does not affect the furnace temperatures appreciably nor reduce the efficiency of combustion. The bricks are laid up with a mixture of ground firebrick and fireclay.

Practically no trouble with slagging of the furnace walls has been experienced; and any trouble that has occurred has been through an unfortunate combination of brick temperature, furnace temperature and kind of coal used. Collecting of slag in the ash pit has been effectually prevented by water-screen tubes across the ash pit, which break the molten globules of ash into fine flakes like talcum powder. The water screens are connected between the mud drum and steam drum. The company does not worry about draining the boilers with this arrangement, because small leaks would have little effect and seamless tubing has little possibility of opening up sufficiently large enough to discharge large quantities of water. While no experience has been had with water screens around the furnace walls to prevent erosion and slagging, the company feels that the size, kind and position of such screens should be selected so that imperfect combustion would not result and smoke ensue. The ashes are discharged by a steam conveyor.

Concludes Slightly Higher Cost Justified

In general, the company concludes that for large installations there is not much difference between the initial cost of stoker and pulverized fuel equipment plants. The powdered fuel plant may cost a little more, but the difference is warranted by the additional economies obtained.

Cost Keeping for Line Construction

By R. A. Miller

Dayton Power & Light Company

THE accompanying unit costs for line construction, which have been derived from data compiled durink the past six months, have been found of infinite value for estimating purposes, for determining the crew which can most efficiently and economically do a particular class of work and for establishing a basis for cost analysis. They are based on the Dayton wage scale for linemen,

TABLE I—SAMPLE OF COST STUDY REPORT SUBMITTED TO DEPARTMENT HEAD TO PERMIT COST CONTROL

Cost of Job 2046—In residence park plat install six 250-c.p. lamps on 16-ft. mast arms and twenty-six 100-c.p. lamps on rigid mast arms. (Work done by A and B gangs)

	Unit Cost	Actual	Estimated
Hauled seventy-seven poles	0.56	$43.19	.....
Gained twelve poles	0.12	1.44	.....
Dug seventy-seven pole holes	2.45	188.61	.....
Set seventy-seven poles	1.40	107.71	.....
Dug sixteen anchor holes	1.62	25.96	.....
Set sixteen anchors	0.82	13.06	.....
Installed two ⅝-in. down guys	0.84	1.67	.....
Installed thirty-three ½-in. down guys	0.636	20.97	.....
Installed seven ⅝-in. pole-to-pole guys	0.55	3.85	.....
Installed sixteen ½-in. pole-to-pole guys	0.95	15.26	.....
Replaced three ½-in. down guys	0.98	2.93	.....
Replaced two ⅝-in. pole-to-pole guys	0.58	1.15	.....
Replaced one ½-in. pole-to-pole guy	1.69	1.69	.....
Installed ninety-six single cross-arms	0.327	31.43	.....
Installed forty-seven sets double cross-arms	0.765	35.92	.....
Changed four single cross-arms	0.27	1.08	.....
Changed thirteen sets double cross-arms	1.57	20.39	.....
Strung 121 spans No. 6 weatherproof wire	0.447	54.14	.....
Hung one 5-kw. arc tub and control	....	23.50	.....
Installed twenty-seven rigid mast-arm lamps complete	2.02	54.44	.....
Installed six non-rigid mast-arm lamps	3.80	22.81	.....
Recovery of material	....	0.83	.....
Hauling time to and from job	....	38.09	.....
Total labor		$710.12	$873.00
Total truck		149.10	56.25
		$859.22	$929.25

TABLE II—CLASSIFICATION OF LABOR ACCOUNTS PERMITTING UNIT COST ANALYSIS

Poles and Guys—New Construction
- B-1 Hauling poles
- B-2 Skidding and handling at job
- B-3 Framing and shaving at job
- B-4 Digging pole holes
- B-5 Digging anchor holes
- B-6 Setting poles (setting includes filling in and tamping)
- B-7 Setting anchors
- B-8 Painting poles on job
- B-9 Installing pole steps
- B-10 Installing ⅝-in. down guys
- B-11 Installing ½-in. down guys
- B-12 Installing ⅜-in. down guys
- B-13 Installing ⅝-in. pole-to-pole guys
- B-14 Installing ½-in. pole-to-pole guys
- B-15 Installing ⅜-in. pole-to-pole guys

Poles and Guys—Maintenance Work
- R-1 Replacing poles
- R-2 Moving poles (includes digging, moving, etc.)
- R-3 Replacing ⅝-in. down guys
- R-4 Replacing ½-in. down guys
- R-5 Replacing ⅜-in. down guys
- R-6 Replacing ⅝-in. pole-to-pole guys
- R-7 Replacing ½-in. pole-to-pole guys
- R-8 Replacing ⅜-in. pole-to-pole guys (Replacing includes removing old and installing new on same pole.)

Supports and Insulators—New Construction
- C-3 Installing single cross-arms
- C-4 Installing double cross-arms
- C-5 Installing pins ad insulators in air

Supports and Insulators—Maintenance Work
- S-1 Changing single cross-arms
- S-2 Changing double cross-arms
- S-3 Chaing insulators (Changing includes removing and replacing on same pole, untying and retying wire.)
- S-10 Transferring single cross-arms
- S-11 Transferring double cross-arms
- S-12 Transferring insulators (Transferring includes removing from one pole to another on same job.)

Conductors—New Construction
- D-2 Stringing No. 6 and smaller wire
- D-3 Stringing No. 4 wire
- D-4 Stringing No. 2 wire
- D-5 Stringing No. 0 wire
- D-6 Stringing No. 2/0 wire
- D-7 Stringing No. 4/0 wire (Stringing includes actual stringing of wire, pulling to specified grade, tying and dead-ending.)
- D-8 Splicing wire on ground
- D-9 Installing D. P. & L. disconnecting switches

Conductors—Maintenance Work
- T-1 Transferring No. 6 and smaller wire
- T-2 Transferring No. 4 wire
- T-3 Transferring No. 2 wire
- T-4 Transferring No. 0 wire
- T-5 Transferring No. 2/0 wire
- T-6 Transferring No. 4/0 wire (Transfer includes untying, moving and retying.)
- T-7 Pulling slack

Transformers—New Installations
- E-1 Hauling transformers
- E-2 Building transformer racks (in banks)
- E-10 Installing 1½-kva. transformer
- E-11 Installing 3-kva. transformer
- E-12 Installing 5-kva. to 7½-kva. transformer
- E-13 Installing 10-kva. to 25-kva. transformer
- E-14 Installing 30-kva. to 75-kva. transformer
- E-15 Installing 100-kva. transformer (Installation includes erection of transformer proper, hangers, braces and fixture arms, making all primary and secondary connections, testing, fuse boxes and blocks, cut-outs or fused switches, lightning arresters, grounds, etc.)
- E-20 Installing arc control
- E-21 Installing 3-kw. arc tubs
- E-22 Installing 5-kw. arc tubs
- E-23 Installing 7½-kw. arc tubs
- E-24 Installing 10-kw. arc tubs
- E-25 Installing 15-kw. arc tubs

Transformer Substation Construction
- E-41 Transformer and
- E-42 Lightning arrester pad
- E-43 Fence
- E-44 Hauling transformers and putting them in place
- E-45 Oxide-film arresters
- E-46 Poles and timbers
- E-47 Burks disconnecting switches and operating handles
- E-48 Fence clips and fuses
- E-49 Choke coils
- E-50 Bus work
- E-51 Ground pipes

Transformers—Maintenance Work
- U-1 Replacing 1½-kva. transformer
- U-2 Replacing 3-kva. transformer
- U-3 Replacing 5-kva. to 7½-kva. transformer
- U-4 Replacing 10-kva. to 25-kva. transformer
- U-5 Replacing 30-kva. to 75-kva. transformer
- U-6 Replacing 100-kva. transformer (Replacing includes removal and installation of one transformer on same job.)

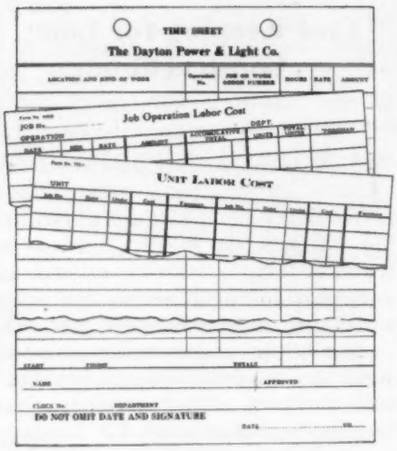
Street-Lighting Fixtures—New Construction
- F-1 Installing 4-ft. bracket lamp complete
- F-2 Installing rigid mast-arm lamp complete
- F-3 Installing non-rigid mast-arm lamp complete
- F-4 Installing span lamp complete

Street Lighting Fixtures—Maintenance Work
- V-11 Transferring 4-ft. bracket lamp complete
- V-12 Transferring rigid mast-arm lamp complete
- V-13 Transferring non-rigid mast-arm lamp complete
- V-14 Transferring span lamp complete (Transferring means from one place to another on same job.)

Right-of-Way
- H-1 Trimming trees (clearing, chopping, etc.)

Recovery of Abandoned Material
- L-1 Recovery of all abandoned material

Miscellaneous
- X-1 Transportation to and from job



RECORDS FOR KEEPING UNIT COSTS IN DISTRIBUTION WORK

Top—Time sheet report from which data are collated. Center—"Job operation labor cost" data recorded here are taken from time sheets. Bottom—Unit labor cost record.

drivers, groundmen and laborers and are for direct labor charges only.

The figures shown were compiled from information reported on daily time sheets. These sheets show the number of hours spent on each operation numbered according to the company's standard "Classification of Labor Accounts-Line Department."

The crew foremen show completed units on their daily time sheets only. It may be observed in the classification, that "Poles and Guys," "Supports and Insulators," etc., are separated into "New Construction" and "Maintenance Work," using different classification symbols for each. This method makes it very simple for the accounting department to separate property and maintenance accounts, an operation which seems to be difficult in most central stations.

The unit data are posted from the time sheets to "Job Operation Labor Cost" cards until the job is completed and unit costs compiled, when they are posted to "Unit Labor Cost" card. The value of work to be done is designated by issuing a work order to cover work estimated to cost under $500 and a job order for work estimated to cost in excess of this amount. The unit costs are kept only on these job orders, as the low cost of small jobs would not warrant going into such detail.

When a job is completed a cost-study report is submitted to the general superintendent, district superintendent, department supervisor engineering department, etc., for their information. This method has proved a simple and an inexpensive way of controlling line construction costs.

TABLE III—UNIT LABOR COSTS IN DOLLARS ON LINE CONSTRUCTION

The key letters A, B, C, etc., denote line crews. In many cases the equipment of these crews differs.

	A	B	C	D	E	F	G	Average Cost, Actual	Fair Average Cost
Digging pole holes	1.70	4.00	2.95	....	1.90	2.75	....	1.99	1.81* / 2.85†
Digging anchor poles	1.10	1.60	3.95	....	2.00	2.60	....	2.01	1.53* / 2.10†
Setting poles	1.30	2.30	2.50	....	1.30	1.50	....	1.37	1.27* / 1.88†
Setting anchors	0.50	1.05	....	....	....	1.35	0.70	0.89	0.80* / 1.18†
Installing ⅜-in. down guys	....	....	0.90	....	....	....	0.75	0.80	0.88
Installing ½-in. down guys	....	1.05	1.55	3.50	....	1.50	1.00	1.42	1.26
Installing ⅜-in. pole-to-pole guys	....	0.80	....	....	....	0.95	1.10	0.91	0.94
Installing ½-in. pole-to-pole guys	....	0.95	0.90	....	2.20	1.20	....	1.30	1.01
Replacing ½-in. down guys (removing old and installing new on same pole)	....	0.90	5.05	....	....	1.15	1.30	1.85	1.20
Installing single cross-arms	0.14	0.53	0.30	....	0.24	0.93	0.37	0.335	0.20* / 0.40†
Installing double cross-arm sets	0.69	0.85	0.76	....	....	0.84	0.72	0.80	0.60* / 0.85†
Changing single cross-arms (including removing and replacing on same pole, untying and retying wire)	....	0.68	2.02	....	....	1.28	0.90	1.32	0.95
Changing double cross-arm sets	....	0.78	....	....	....	1.36	1.33	1.08	1.16
Transferring single cross-arms (including transfer from one pole to another)	....	0.45	0.62	....	....	....	....	0.58	0.53
Transferring double cross-arm sets	....	1.05	1.28	....	....	....	....	1.25	1.15
Stringing No. 6 wire, per span of single wire‡	....	0.47	0.53	....	....	0.38	0.53	0.4625	0.48
Stringing No. 4 wire	....	0.59	....	....	....	0.50	....	0.484	0.51
Stringing No. 2 wire	....	0.74	0.70	....	....	0.92	....	0.863	0.68
Stringing No. 2/0 wire	....	0.63	....	....	....	0.76	....	0.751	0.76
Transferring No. 6 wire	....	0.38	0.56	....	....	0.57	....	0.533	0.50
Transferring No. 4 wire	....	....	1.65	....	....	0.72	....	1.05	0.56
Installing 1½-kva. transformer, complete	....	4.30	....	....	....	8.25	....	5.85	4.28
Installing 3-kva. transformer, complete	....	....	11.20	....	....	....	11.30	11.17	6.50
Installing 5-kva. to 7½-kva. transformers, complete	....	4.75	9.75	....	....	11.30	....	8.83	8.26
Installing 10-kva. to 25-kva. transformers, complete	....	....	7.60	....	....	....	10.50	7.95	9.02
Installing 30-kva. to 75-kva. transformers, complete	....	15.60	22.70	....	....	10.60	....	17.23	13.06
Installing rigid mast-arm lamps, complete	....	2.95	....	....	....	....	....	2.97	2.97
Installing non-rigid mast-arm lamps, complete	....	4.15	....	....	....	4.10	....	4.125	4.12
Transferring rigid mast-arm lamps, complete	....	....	....	....	....	4.38	....	4.38	4.38
Transferring non-rigid mast-arm lamps, complete	....	3.10	....	....	....	4.70	....	3.86	3.70
Transferring 4-ft. bracket lamp, complete	....	2.29	....	....	....	....	....	2.23	2.23

* Labor crew. † Line crew. ‡ Stringing wire includes stringing, pulling to specified grade or sag, tying in and dead-ending.

Derrick Truck for Maximum Lift of 5,000 Lb.

A 2½-TON special derrick truck designed for use in setting and removing poles of any size that the Union Electric Light & Power Company uses has been added to the overhead division since the first of the year. The body has been kept to a minimum weight, being shorn of all extra or unnecessary parts. Rows of bins for tools and material are located along the sides, both above and below the truck frame.

The derrick truck more than justified the equipment in handling poles during the sleet storm which struck St. Louis last winter. Sixty poles were raised in one day by this truck. It is operated from a power-driven winch located back of the seat and is capable of lifting a load of 5,000 lb.

While figures are not available as to the actual saving resulting from the use of this truck, nevertheless the improved method of doing its particular work represents a tremendous saving of time and is of great value in speeding up the work of extending new lines and in the repairing of old lines.

DERRICK TRUCK SETTING POLE IN ST. LOUIS

So efficient has been the work performed by this truck and so much an improvement over other methods has this new equipment made possible that the company has ordered two more derrick trucks for its overhead crews.

Commercial Activities and Public Relations

Electrical Training for Industrial Plant Engineers

TO PROVIDE the foreman and superintendents having charge of the electrical equipment in industrial plants with more complete and detailed knowledge of electrical apparatus and the use of electric power, an organization known as the Electrical Maintenance Engineers of Cleveland has been formed. It is made up of those men who supervise and maintain as well as purchase electrical equipment for the industrial plants of Cleveland. The organization is sponsored by the industrial section committee of the Electrical League of Cleveland and holds monthly meetings at which various phases of the industrial application of electricity are demonstrated and discussed.

In planning the meetings for 1925 it was decided that each meeting be centered about one particular electrical industrial application or group of related applications and that in addition to the prepared talks and discussions of the formal meetings practical exhibits and demonstrations of the application under consideration be given. The accompanying schedule of meetings shows the variety of applications covered, including one on "Selling the Boss" to help the maintenance engineer in his work of keeping the executives "sold" on modern electrical equipment.

The first five meetings have been completely successful. There has been an average attendance of more than 200 members at each meeting and the discussions over the exhibits and prepared addresses have shown that such meetings are an important adjunct to the industry's growth.

SCHEDULE OF MEETINGS OF ELECTRICAL MAINTENANCE ENGINEERS FOR 1925

Exhibits are to be set up and demonstrations are to be made in connection with each subject.
February 2: "Electrical Circuit Protective Devices."
March 2: "Meters."
April 6: "Cranes and Hoists."
May 4: "Small Tools."
June 1: "Starters and Controllers."
September 14: "Heating."
October 5: "Motors and Power Factor Correction."
November 2: "Obsolescence and the Economics of Power Distribution."
December 7: "Welding."
"Maintenance Records" and "Selling the Boss" are additional subjects to be discussed during the year.

Purchased Power Shows Marked Saving Over Private Plant

Machine Tool Factory Abandons Steam Plant—Annual Savings at Rate of 50 per Cent on Investment—How Load Was Secured

BY R. H. LARSON
Power Engineer Rockford Electric Company, Rockford, Ill.

SO MANY isolated plants have given place to central-station service during the last few years that it seems that there should be but few such prospects remaining. The fact is that there are today hundreds of private plants, many of which are possible customers but whose owners are not to be converted by general statements, nor intrigued by formidable looking reports. The confidence of the prospect is today, as in former years, the first and foremost objective to be sought. Afterward the facts are to be stated forcefully, accurately and as briefly as possible. If this plan is kept in mind and the power company has a real case, the outcome of the negotiations will be successful more often than not.

A large manufacturer of machine tools in Rockford, Ill., who operated a private plant for many years prior to 1924 is a typical case of this kind. The objection always raised against purchased power had been the need of steam for building heating and all previous attempts to secure the business had stuck on this snag. However, in 1924 actual records of

TABLE I—MONTHLY COAL CONSUMPTION WITH STEAM POWER

Month	Tons of Coal Burned: Night Shift, 6 p.m. to 7 a.m.	Day Shift, 7 a.m. to 6 p.m.	
July	16.8	57.4	
August	23.8	58.8	
September	19.6	51.1	
October	21.4	59.4	
November	28.6	83.4	
December	101.1	104.7	
January	156.2	145.2	
February	132.0	123.5	
March	28.5	112.0	
April	22.3	105.8	
May	21.0	91.5	
June	17.0	75.0	
Total for year	588.3	1,067.8	
Grand total, tons			1,656.1

ATTENDANCE OF ELECTRICAL MAINTENANCE ENGINEERS AT LECTURE ON "METERS"

this plant's coal consumption by months and by day and night shifts became available. With these data as the basis, a new attempt to get the business was made.

In making an investigation and submitting a proposition it was realized that the confidence of the prospect must be secured and maintained if the report was to be given a fair reading. With this in mind, every effort was made to impress the prospect with the sincerity of the motive behind the investigation. The prospect was assured that facts were the sole object of the investigation and that the power company was willing to rest its case on the facts as disclosed. This policy induced the prospect to ask for a report and this initial victory insured favorable consideration of the report.

OPRATING CONDITIONS AS FOUND

Operating conditions were studied from the coal pile to the line shaft. Coal records were tabulated, labor costs were established, maintenance expense was determined and all items were set down in detail as shown in the accompanying table. The steam-power equipment consisted of two boilers of 250-hp. rating, operating at 105 lb. pressure. The factory was driven by a non-condensing Corliss engine of 300-hp. rating and running at 83 r.p.m. The engine drove the factory by means of a main belt drive, four rope drives and two mule drives.

Load tests were run on the engine, and fuel consumption was determined at the same time. These tests showed a coal consumption of 6.8 lb. of coal per indicated horsepower-hour. The actual coal consumption for one year is given in the accompanying table.

DETERMINATION OF HEATING REQUIREMENTS

An analysis of the coal records showed that no appreciable amount of coal was used for night heating—standby losses accounting for 20 tons per month—except during the three coldest months of the year, December, January and February, when the total of 389 tons burned was chargeable to night heating. For the day shift during the seven heating months from November 1 to May 30, a total of 766 tons was used. The percentage of this amount which was actually used for heating depended mainly on the relation between exhaust steam available at times of moderate outdoor temperatures and the heating demand. As

TABLE II—COMPARATIVE COSTS WITH PRIVATE PLANT AND PURCHASED POWER

Item	Steam Power	Purchased Power	
Coal	$6,485	$2,100	
Labor	4,654	3,000	
Maintenance	730	400	
Purchased power:			
28,800 kw.-hr. @ $0.0325	936	.....	
142,800 kw.-hr. @ $0.026	.....	3,710	
Total	$12,805	$9,210	
Annual saving with purchased power			$3,595

live steam had been required only during the coldest weather, it was estimated that 30 per cent of the total exhaust steam available was lost during mild weather. Deducting an additional 10 per cent for losses through the engine, etc., there remained 60 per cent of 766 tons, or 460 tons, for daytime heating. The total of 850 tons for heating, arrived at in this manner, was found to be 130 tons high when compared with the actual experience of factories of similar construction and use. Using purchased power, it would be possible to close off part of the building, and under this arrangement it was estimated that the coal consumption would not exceed 600 tons with the plant running light.

DETERMINATION OF POWER CONSUMPTION

Engine indicator tests showed the following loads: Average engine load, 142 hp.; average load of engine and shafting only, 117 hp.; difference or net useful load at machine tools, 25 hp. Deducting engine losses, main drive, rope drive, mule drive and such shafting as could be stopped a portion of the time when using electric motors gave a net live load for electric power equipment of 60 hp. With a motor efficiency of 83 per cent and factory operation of 176 hours per month, the annual power consumption was computed as 114,000 kw.-hr. Adding the existing purchased power consumption of 28,800 kw.-hr. made a grand total power consumption with central-station service of 142,800 kw.-hr. per year. The present consumption is at the rate of 139,000 kw.-hr. per year.

50 PER CENT RETURN ON INVESTMENT

The annual saving in operating costs, as shown in the accompanying table, was estimated at $3,600 for load conditions existing at the time of the test. A sufficient number of motors have now been installed at a cost of approximately $3,000 to allow the shutting down of the engine, and the management believes this investment will be repaid by the first year's savings. Complete electrification for full load conditions will cost about $10,500, with a computed saving of $5,351 per year.

Electric Power for Oil-Well Drilling

MOST interesting figures showing the savings to be made by the use of electric power for oil-well drilling are contained in the recent serial report of the N. E. L. A. power committee covering experiences with different installations in the oil fields. Data giving the kind of electrical equipment required for this work are included in the report, together with a comparison of the cost of steam and electrically drilled wells as shown in the tabulation herewith. Over-all figures show the cost per foot of a well drilled electrically to be $1.02 against $1.50 per foot with steam equipment. The accompanying comparison shows the costs on steam and electrically drilled wells.

COMPARATIVE COST FIGURES ON STEAM AND ELECTRICALLY DRILLED WELLS

	Steam	Electric
Well	Del Amo No. 2	Del Amo No. 3
Power	.....	.....
Depth	3,530	3,516
Formation	Sand and shale—average hardness	
Casing	882 ft. 15½ in. 2,947 ft. 10 in. 3,530 ft. 8¼ in.	758 ft. 15½ in. 3,014 ft. 10 in. 3,516 ft. 8¼ in.
Total hp. installed, motors and boilers	280	200
First cost of power equipment	$9,441.76	$4,932.91
Transportation and installation cost	$1,158.30	$1,214.94
Total cost installed	$10,600.06	$6,147.85
Kilowatt-hours used	.....	94,344.00
Cost at $0.0188 per kilowatt-hour	.....	$1,773.00
Gas fuel used, cu.ft.	94,373.00	.....
Cost at 25 cents per 1,000 cu.ft.	$2,359.37	.....
Maintenance	$85.00	$88.50
Repairs and depreciation	$1,270.25	$280.90
Cost of disconnection at completion of well	$129.15	$27.62
Fixed charges—interest at 6 per cent, taxes at 1 per cent and engineering at 0.5 per cent	$331.94	$170.09
Total operating cost	$5,320.01	$3,595.05
Cost per foot of hole drilled	$1.50	$1.02

Pacific Gas & Electric Sales Program

Problem of Marketing 150,000 Kw. of New Capacity Causes San Francisco Company to Organize Large Commercial Force for Extensive Selling Operation

CONFRONTED with the problem of marketing an enormous block of surplus hydro-electric power, the Pacific Gas & Electric Company, San Francisco, Cal., has organized an intensive sales campaign to dispose of 35,000,000 kw.-hr. and take on 150,000 kw. of new business between now and the end of the year. With the bringing in of its 80,000-kw. Pit River No. 3 plant early in July the company will have a surplus of power even without the additional expected 70,000 kw. from Hetch Hetchy, San Francisco's municipal plant, which the city is seeking to have the company distribute. The sales campaign that is being developed to market the great block of power will probably constitute the largest undertaking of its kind in the history of the electrical industry.

Selling effort will be concentrated on electric ranges, water heaters, air heaters, domestic, commercial and industrial lighting, domestic electric refrigeration, industrial heating and electric trucks. Sales will be made through (1) direct solicitation of consumers and (2) by an attractive dealer policy. To carry out direct consumer sales there will be added to the present force 200 men, who will work on a salary and commission basis. The company has announced a policy that will allow the dealers to sell on the same terms as the power company and make the same merchandising profit.

RANGES, WATER AND AIR HEATING

Special emphasis will be laid on electric ranges, water heaters and air heaters. In the opinion of the company the greatest sales resistance to the electric range has been the cost of wiring. To remove this obstacle range and water heater wiring will be subsidized by the company. Ranges will be wired in for a flat figure of $54 cash, or $60 on time in cities, and $36 cash, or $40 on time in rural communities. Ranges will be sold at list price by the company and dealers alike. If the range sale is made by a dealer, the company will carry the range wiring paper and the dealer the range paper.

Many dealers, particularly the large department stores, household furnishing stores, hardware stores and furniture stores, have complained in the past that the margin of profit on the electric range was not sufficient, and they were not justified in handling them. To gain the active support of these dealers, the Pacific Gas & Electric Company will buy in large volume and resell to the dealers, who will be allowed a liberal discount. Under these plans the company expects to sell 4,000 ranges and 2,000 water heaters during the next six months. Sales of ranges and water heaters alone are expected to aggregate more than a million dollars. To get an initial installation of electric heating in the home a special campaign will be put on to sell bathroom heating. A kitchen unit campaign supplemented by a direct lamp-selling drive is planned.

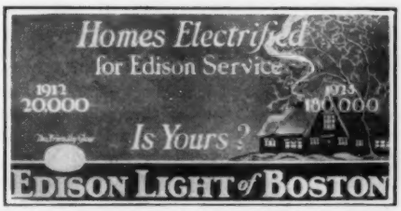
STORE LIGHTING

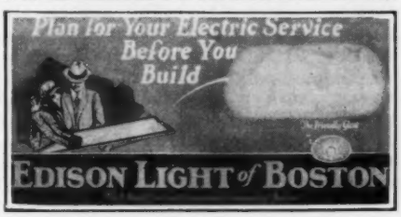
Commercial lighting also will receive special attention. Lighting demonstrations will be put on in every town and city served, and these demonstrations will be followed up by direct solicitation. Wiring of installations sold will be left to local contractors. In addition, a co-operative plan has been worked out with sign manufacturers to increase the use of electric signs, and special men will be assigned to industrial illumination. The company will not handle household refrigerators, but will canvass prospects and assist the manufacturers in making sales.

An exceptionally large industrial electric heating program has been worked out, in which manufacturers will co-operate, and sales will be made with an absolute guarantee of satisfaction. The company has set up a revolving fund of $60,000 to finance trial installations and back up this guarantee, the plan being to have the wiring installed by a contractor and paid for by the company, subject to the satisfaction and approval of the customer. Meanwhile an intensive drive is to be made to close down the few remaining isolated plants and replace them with central-station service.

The Pacific Gas & Electric Company in this sales campaign has planned to conduct a prolonged continuous effort, as there is sufficient generating capacity in sight to serve all the business that it will be possible to sell for several years. The Pacific Gas & Electric Company stands in a peculiar position in that it supplies gas service in much of the territory covered by its electric lines, but it is expected that electric business can be developed so that it will not seriously disturb the present gas business.

House-Wiring Advertising Used by Boston Edison





STREET-CAR advertising cards like those reproduced above have been effectively used this spring to stimulate house wiring on the Boston Edison system. Each carries a pictorial appeal to the home owner's imagination.

Brooklyn Edison Chauffeurs Visit Traffic Court

A FIRST-HAND lesson on traffic was given to chauffeurs employed by the Brooklyn Edison Company at the city Traffic Court recently, where they saw three magistrates struggling with more than 700 violators of street regulations. President M. S. Sloan wishes every one of the men who operate motor cars belonging to the Brooklyn Edison Company to see for himself what happens to those who persist in ignoring traffic laws. Other Brooklyn firms operating big fleets of motor trucks expect to follow the example set by the Edison company.

When the magistrate asked his visitors what they thought about a physical examination for those applying for motorcar drivers' licenses, several answered at once, "We Edison fellows all have to pass such an examination," which evidently pleased the court, who is a stanch advocate of a statute requiring such physical examination.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Water-Power Resources of the World.—Correspondence is published, received through the secretary of the international executive committee of the World Power Conference, on J. W. Meares' article in the January issue. It deals with the effort to reduce to a common basis the reported data on available water power and emphasizes the need of international agreement on this point so that the figures may be comparable. The present correspondence relates to Norway, Sweden and France.—*World Power*, May, 1925.

Over-All Economy of Diesel Engines.—C. B. JAHNKE.—After pointing out that obsolescence of the oil engine because of lack of fuel is not at present to be seriously considered, in view not only of the probable future discovery of additional supplies but of the commercial feasibility of using coal by-products and shale oil, the writer submits data on first cost, operating expenses and fixed charges for a number of pumping plants, service records of Diesel municipal power plants, with the corresponding operating costs, and finally a comparative table of oil-engine, steam and motor-driven pumping plants. He holds that the initial brake thermal efficiency of 32 per cent is permanent and obtainable in everyday operation and cites records to show that, contrary to the assumption of necessarily high fixed charges in view of the rather high first cost of the oil engine, these charges are really moderate because of the long useful life, which, he states, can with the utmost safety and conservatism be set at twenty-five years. Charts are given for the heat balance and for various economic relations involved in the discussion.—*Power Plant Engineering*, May 15, 1925.

Generation, Control, Switching and Protection

Dimensioning of Copper Conductors for Heavy Overloads.—R. EDLER.—Generators, switches and transformers of modern power plants and substations are designed and built today to be as short-circuit-proof as possible. Little attention has been paid so far to such dimensioning of the many connections between these pieces of apparatus as to make them also short-circuit-proof. The author does not mean to space and to anchor these wires in such a way as to resist dynamic action of short-circuit forces, but has in mind only the proper size of the wires to prevent dangerous heating. Under the assumption that the overload or the short circuit is of such short duration that no appreciable dissipation of heat takes place, he develops two heating formulas—one for approximation and the other an exact mathematic equation, taking into account the change in conductivity and specific heat during the period of excessive heating. Tabulations and curves are given to show permissible current ratings for temperature rises of 50, 100, 150 and 200 deg. C., and a number of standard copper cross-sections for time intervals from one-fourth of a second up to several minutes.—*Elektrotechnik und Maschinenbau*, May 3, 1925.

Electric Field of Eddy-Free Conductors.—L. FLEISCHMANN.—To insure equal reactance of a number of parallel conductors in generator slots, it is necessary to transpose these conductors during their passage through the slot. This becomes necessary because of the unequal flux distribution within the slot, which in turn would cause an assymmetrical current distribution among the individual members of the conductor. Such artificially assembled conductors are used widely on large output machines. The author augments the existing theory on this subject by showing that every member of such a transposed multi-conductor must fulfill the condition

$$\int_o^L \left(\frac{k}{h}\, y^3 + y\right) dx = \text{constant},$$

wherein y denotes the distance from the base of the slot, x to be taken parallel to the slot axis, the length of which is L. He shows further that the apparent resistance of such a composite rod varies with the number of layers for the same depth of slots, but is independent of the arrangement of the component conductors for the same number of layers.—*Elektrotechnische Zeitschrift*, May 14, 1925.

Transmission, Substations and Distribution

Calculation of Single-Phase and Polyphase Short-Circuit Current.—F. OLLENDORFF.—In this long and theoretical paper the author calls attention to the great importance which the exact knowledge of the magnitude of the short-circuit current has in extended power networks. Considering the various factors which determine the magnitude of the short circuit, the writer develops mathematical and graphical methods to calculate these currents. The entire article is based upon the ideal short-circuit with zero ohmical resistance, an assumption which gives a practically satisfactory approximation. The author also neglects all capacity phenomena, admitting that for very long lines and for double-pole and triple-pole short circuits such a simplification will not always be permissible, and that, in addition, under such circumstances resonance phenomena may occur which are not taken care of by his method of calculation.—*Elektrotechnische Zeitschrift*, May 21, 1925.

Electric Distribution Network of the Pacific Gas & Electric Company.—S. J. LISBERGER.—This network covers thirty-eight counties, serves a population of 2,000,000 people and includes 8,434 miles rated at 20 kv. or less and many miles of 60-kv. lines for bulk distribution. Much of the power consumption is for agricultural purposes, with a connected motor load of 176,347 hp. in installations usually of 25 hp. or less. There is also a considerable mining load in addition to the urban load of the large population centers served. The article under consideration, which is accompanied by maps and views, gives details regarding this network.—*Electric Journal*, June, 1925.

Units, Measurements and Instruments

Properties and Testing of Magnetic Materials.—Parts III and IV.—T. SPOONER.—This article is devoted to characteristics of commercial and semi-commercial materials, each being taken up individually. The properties are shown in a large number of charts and in the form of other data. The effect on the hysteresis loss of the usual elements in steels is reduced to the form of equations involving a term for each constituent. The materials discussed are pure commercial iron, cast iron, cast Bessemer, open-hearth, silicon and aluminum steels, vacuum iron, nickel, cobalt, iron-nickel alloys, iron-cobalt alloys, Heusler alloys, non-magnetic steel and non-magnetic cast iron.—*Electric Journal*, April and May, 1925.

Calculating Forces in Bent Helical Springs.—R. ZEIGLER.—The design of various apparatus calls for helical springs which are subjected to side thrust, or, in general, to thrusts not in the direction of the straight axis of the spring. Instead of relying upon mere empirical determination, the author attempts to develop an accurate theoretical approach to this problem, basing his calculations on the known equations of the elastic form changes of bent rods. This highly mathematical paper contains a number of practical examples to show the use in concrete cases of the formulas arrived at. The study comprises straight side thrust, quarter circular thrust and "S" thrust of helical springs.—*Elektrotechnische Zeitschrift*, June 4, 1925.

High-Voltage Laboratories.—J. REYVAL.—The author gives in this paper a general summary of the high-voltage laboratories existing in Europe, together with a description of the various methods known and employed to generate extreme high potentials of commercial frequency, high frequency and with impulse characteristics. There are at present two institutions abroad where a voltage of up to 1,000 kv. may be produced—one in France with three air-insulated transformers in chain connection and an output of 160 kva.; the other one in Germany with eight oil-insulated transformers with a capacity of 200 kva.—*Revue Générale de l'Electricité*, May 30 and June 6, 1925.

Illumination

Prediction of Daylight from Vertical Windows.—H. H. HIGBIE.—This paper, presented before the annual convention of the Illuminating Engineering Society at Briarcliff Manor, represents an attempt to put the predetermination

of daylight in a building on a rational basis, so as to give not merely average values of illumination but minima and maxima as well. The problem is attacked theoretically and practically. Numerous cases of light distribution on a horizontal plane from wall and roof windows are shown graphically, as calculated from comparatively simple formulas, with checks by tests on laboratory models. An abstract of the paper may be found in the ELECTRICAL WORLD report of the convention, November 1, 1924, on page 961.—*Transactions of the I. E. S.*, May, 1925.

Daylight Recording by the New York Edison Company.—WALTER R. BOYD.—*Daylight Recording by the Edison Illuminating Company of Boston.*—H. J. BAKER.—The methods in use by two companies for procuring continuous records of the intensity of daylight are described in these papers, which formed part of a symposium on "daylighting" at the annual convention of the Illuminating Engineering Society at Briarcliff Manor, N. Y., October 27-30, 1924.—*Transactions of the I. E. S.*, May, 1925.

Motors and Control

Space Requirements of Coil Heads.—M. DUFOUR.—The exact configuration of coil heads on electric generators, motors and induction regulators is being determined almost universally by the graphic method; that is, on the drafting board. The author claims that much quicker progress can be made if the designer of the machine calculates mathematically the space required for all such coil heads, provided that the number, size, insulation and type of machine are known. He develops in this article a strictly trigonometrical method for this purpose, at the conclusion of which he gives some data for the more generally used types of windings. The method covers open coil heads and those which are partly or completely supported and anchored.—*Revue Générale de l'Electricité*, May 30, 1925.

Heat Applications and Material Handling

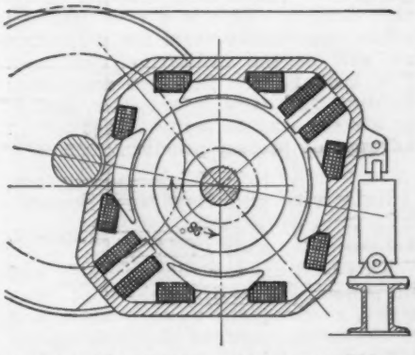
Electric Automobiles and Trucks.—T. PAUSERT.—The French Automobile Club, in collaboration with the French electrical syndicate and a number of manufacturers, has carried out another series of tests on electrically propelled street vehicles, similar to the tests made last year. The present elaborate paper brings together descriptive and test data of the various cars and accessories represented in these service and traction trials. A total of sixteen cars and trucks participated in the tests, which were made in Paris and near-by suburbs. The article contains a complete description and data on all entered cars and drawings and wiring diagrams of most of them. It seems that electrically propelled pleasure cars enjoy a considerable popularity in Paris, where the supplying of charging current for the many batteries constitutes a sizable central-station load at night.—*Revue Générale de l'Electricité*, May 16 and 23, 1925.

Electrophysics, Electrochemistry and Batteries

Modern X-Ray Tube Development.—WILLIAM D. COOLIDGE.—This address, delivered on the occasion of the celebration of the centenary of the founding of the Franklin Institute, consists in the main of a discussion of some of the physical principles involved in the hot-cathode type of X-ray tube and deals with the factors which most strongly influence the characteristics and behavior of such tubes. For the production of short wave-length X-rays tubes are now made to operate satisfactorily at voltages up to 250,000. Voltages greatly in excess of this are available, and the question of whether much shorter wave lengths can be produced resolves itself into the question of whether tubes can be made which will operate at such high voltages. For the use of the dentist a very small tube has been developed to operate in the same oil and in the same metallic container as the transformer, making a compact set that is also well adapted to certain lines of physical investigation and demonstration. These various topics are treated at length in a descriptive way, with diagrams, views and Röntgenograms showing the distribution of the radiation under various conditions.—*Journal of Franklin Institute*, May, 1925.

Traction

New-Type Railway Motor.—W. OEISCHLAGER.—The many advantages inherent in small running wheels on street cars and mine locomotives call for electric motors of exceedingly small compass. If such small wheels are combined with narrow gage, the designer is frequently unable to provide a motor of the desired output which can be contained in the small room available. The new type of motor described in this paper solves this problem in a simple and ingenious manner. The cross-section of the four-pole motor, instead of being, as usual, square, is rhombic; that is, the angle between the center line through the vertical poles stands at 98 deg. to the center line through the two horizontal poles, as shown herewith. Instead of four commutating poles the motor has only two, placed in the longer axis of the rhombus. Such a construction has a number of advantages. The receding side of the motor can be brought very close to the car axle without lessening the yoke-iron cross-section unduly. The middle of the motor is above the wheel center, thus giving more clearance between motor and road. The motor can be suspended closer to the truck body. For the average street-car motor, with an output between 35 hp. and 40 hp., two commutating poles can be made fully as effective as the usual four auxiliary poles.—*Elektrotechnische und Maschinenbau*, April 26, 1925.



SPECIAL MOTOR DESIGNED FOR SMALL-WHEEL STREET CARS AND MINE LOCOMOTIVES

Electrification of Swiss Federal Railways Progressing Rapidly. — This article contains a description, with maps and views, of railway lines in Switzerland and an outline of the program according to which 973 miles, comprising nearly all the main lines, are to be completed by the end of 1928. The total cost of the undertaking is estimated at about 760,000,000 Swiss francs, equivalent at the present rate of exchange to $140,000,000. Distribution of expenditures is expected to be about as follows (expressed in percentages): Hydro-electric plants, 21.5; transmission lines, 8.0; substations, 8.5; catenary construction, 18.0; rolling stock, 30.0; miscellaneous, 14.0. Single-phase current at 15,000 volts, 16⅔ cycles, has been adopted as standard except on the 13.6-mile section of the Simplon Tunnel, which is to be operated with three-phase current. A table of specifications for eight types of single-phase locomotives is included. *Electric Railway Journal*, May 9, 1925.

Telegraphy, Telephony, Radio and Signals

Telephone Transmission Unit.—F. B. JEWETT.—Commenting on the controversy over the choice of units in recent articles in the *Electrician*, the author calls attention to the need of agreement as to the "conventions"—that is, understandings—which go with each unit as to how it is to be used, its significance under different conditions, certain equivalences in circuits and apparatus, etc. By suitably choosing these the $\beta\lambda$ unit advocated by Dr. Breisig and the *TU* unit favored by Mr. Hartley can be so defined as to differ only in size. The use, in computation, of $\beta\lambda$ by a few highly trained development specialists simultaneously with the use of *TU* by the "practical" men has not been a matter of importance. The writer finds that experience with the *TU* unit has been so satisfactory that its choice seems to have been a wise one.—*Electrician* (*England*), May 15, 1925.

Burglar Alarm with Wood as Part of the Circuit.—W. BLUT.—Utilizing the Johnson-Rabeck effect, the paper explains a novel use of electricity suitable primarily for burglar alarms. A voltage as low as 220 may be used to energize from the light circuit an arrangement of sensitive relays where the armature retaining current has been measured to be as low as half a millionth of an ampere. For currents of such low value wooden floors, plaster walls, etc., have been found to conduct sufficiently well to form parts of the circuit.—*Elektrotechnische Zeitschrift*, June 4, 1925.

New Books

Technology of Lighting

By M. E. Zelentsoff. 432 pages, 179 illustrations. Petrograd: Kubuch.

The introduction to this treatise contains a synopsis of physiological knowledge of the human eye. The influence of different factors on eye troubles are discussed and illustrated in the light of recent data, and the main technical problems of lighting are pointed out.

The first part of the book is devoted to the general problems of generation of light. In the first chapter some fundamental optical facts are given concerning the nature of light, black-body radiation, etc. The second chapter deals specially with photometric units, and a little lack of clearness and exactness is manifest. The third chapter deals with the methods of photometric measurements and corresponding instruments. Many types of photometers are described. Chapters four to nine are devoted to an elaborate description and discussion of different types of lamps—arc, incandescent, gas-filled, etc. A chapter is devoted to mercury-arc lamps and another to neon lamps and the Moore light.

The second part of the book deals with problems of illuminating technology and the distribution of light energy for illumination. The first two chapters discuss the fundamental notions of brightness, visibility, etc. Chapter III is a discussion of the influence of the position of the light source upon the qualities of illumination, and Chapter IV contains an extensive description of different luminaires. The fifth chapter deals with the theoretical methods of computing the necessary distribution of light energy and discusses in detail the influence of various factors on the illumination. The last chapter of the book deals briefly with the economic side of all the problems discussed.

How to Build Furnace Efficiency

By J. W. Hayes. Seventh edition. Michigan City, Ind.; Jos. W. Hays and Associates. 534 pages, illustrated. Price, $2.75 to $3.50, according to binding.

The author has treated the rather technical subject of combustion in a popular way. The engineer glancing over this book for the first time may be a little shocked at some of the cartoons. They may strike him as rather rough and crude. The book is avowedly breezy both in text and pictures. That such a book meets a real need, however, is evidenced by the fact that this is the seventh edition—the first was in 1908—and that 120.000 copies have been printed to date. This seems to demonstrate a demand for a "painless" presentation of the subject of combustion that will make a hit with the ordinary non-studious engineman or fireman. From start to finish the book is full of rough and ready humor. Yet a lot of real information on combustion is inclosed between its covers. There is little question that this book has done and will continue to do much good in getting combustion principles across to those who rebel at the ordinary rather dry presentation.

In the present edition sufficient charts, diagrams and illustrations, outside of the cartoons, have been added to make clear some of the things that it is hard to explain in text. Many instruments and apparatus have been illustrated for the sole purpose of showing the "tools" that combustion men are using in working out specific furnace efficiency problems.

Lighting Fixtures and Lighting Effects

By M. Luckiesh. 329 pages, illustrated. New York: McGraw-Hill Book Company, Inc.

An interesting book on the subject of the use of artificial light from both the utilitarian and the artistic standpoint, covering the historical development of the use of light and the equipment used with the different kinds of illumination. The author puts into words an appreciation of the great potentiality of modern artificial light and lighting fixtures as decorative elements rather than purely as substitutes for the flames or lamps used in past history. It is shown very clearly that decorative elements in lighting do not in any way interfere with the scientific control of light.

In a discussion of fixtures the author goes back in history to show the background for the development of the commercial fixtures of today and presents many interesting designs which embody new ideas. He also brings out clearly the possibility of using light to get artistic effects independently of fixture designs. This is a new field and offers opportunity from the decorative as well as the utilitarian viewpoint. The book is rich in ideas concerning lighting and very informative, and it points the way to many things far in advance of present practice.

Relativity and Common Sense

By F. M. Denton. 279 pages, illustrated. London: University Press.

This book discusses interestingly and in popular terms the theory of relativity, checking the measurements and mathematical portions of the theory by the use of logic and common sense. The book is replete with scientific psychology and with practical illustrations of the meaning of some of the recondite theories of relativity. The author does not hesitate to branch out into all the realms of science and of practical affairs for his illustrations. He points out the fact that relativity explains many phenomena in present scientific theories which from a common-sense standpoint are apparently absurd. It is emphasized, however, that the general theory of relativity cannot be accepted until all the mechanical phenomena and electrical phenomena are brought into the system. Once all physical science is a part of the relativity system, the author asserts, general theory will have the logic and consistency of pure geometry. The theory of relativity is presented from the view of Professor Eddington in his book entitled "Space, Time and Gravitation," published in 1920 by the Cambridge Press.

Book Notes

Electrical Directory of Australia and New Zealand, Melbourne: Tait Publishing Company.

This the sixth edition follows the general arrangement of previous editions. A new trade section has been included in this edition comprising a list of electrical firms which includes the local representatives or agents of foreign firms, as well as a classified list of electrical equipment.

The Production and Measurement of Low Pressure. By M. H. Newman. 187 pages, illustrated. London: Ernest Benn, Ltd.

Realizing the importance of high vacua in modern times, the author has discussed the various methods of producing these vacua. The details of various processes—such as mercury pumps, mercury-vapor pumps, the absorption processes, chemical, thermal and electrical processes and manometers for low gas pressures are covered thoroughly and there is a general discussion of exhaust procedure. Tables and detail data are given on the various methods. The book is sure to be valuable to many engineers and scientists.

Elektrische Gleichrichter und Ventile. By A. Gunther-Schulze. 181 pages, 88 illustrations. Munich: Joseph Kosel & Friedrich Pustet.

In the shape of a small book for the pocket the essential theoretical and practical fundamentals of all the known methods of transforming alternating current into direct current are given in this volume. The bulk of the information covers mercury-arc rectifiers. All the illustrations are bound together at the end of the text, a plan which cannot be recommended, since it hinders the reader.

Laboratory Manual of Electrical Science. By R. O. Buck and H. E. Frost. Milwaukee: Bruce Publishing Company. 160 pages, illustrated, $1.44.

This book is a loose-leaf electric laboratory manual consisting of a series of fifty experiments for a full year's work. It explains in a clear manner the general principles of electricity from magnetism to the simpler phases of alternating current applied to motors and generators.

The "Electrician" Annual Tables of Electricity Undertakings for 1925. Thirty-eighth edition. London: Benn Brothers, Ltd. 172 pages.

Details of steam and hydro-electric plants, transmission lines, distribution systems and substations are given for all the cities and towns of Great Britain and of the British colonial possessions. Similar data are also given for most of the cities of the other countries of the world.

Books Received

The Application of Hyperbolic Functions to Electrical Engineering Problems. By A. E. Kennelly. New York: McGraw-Hill Book Company, Inc. 352 pages, illustrated. Price, $3.50.

Mechanical Design of Overhead Electrical Transmission Lines. By Edgar T. Paintor. 274 pages, illustrated. New York: D. Van Nostrand Company. Price $6.

Alternating Currents and Transients. By F. M. Colebrook. New York: McGraw-Hill Book Company, Inc. 195 pages, illustrated. Price, $3.

Physics in Industry. By J. W. Mellor, A. E. Oxley and C. H. Desch. New York: Oxford University Press, American Branch. 48 pages; illustrated. Price, $1.

Switchgear for Electric Power Control. By E. Basil Wedmore and Henry Trencham. New York: Oxford University Press, American Branch. 335 pages, illustrated. Price, $8.35.

Chemistry and Engineering Materials. By Robert B. Leighou. New York: McGraw-Hill Book Company, Inc. 538 pages, illustrated. Price, $4.

Market Analysis. By Percival White. New York: McGraw-Hill Book Company, Inc. 438 pages, illustrated. Price, $4.

News of the Industry

Muscle Shoals Power Sold

Alabama Power and Southern Companies to Take Output During Test Period

REVENUE in excess of $500,000 will accrue to the federal treasury as the result of an informal agreement which will permit the distribution of the power developed at Muscle Shoals during the testing period. The Alabama Power Company, on its own account and on behalf of the other power companies forming a part of the southern interconnected system, has agreed to pay 2 mills per kilowatt-hour for this power, with the understanding that the supply of power may be shut off without warning and with no assurance as to the amount of power which is to be made available at any time. The arrangement gives the government the advantage of testing out the equipment under full load conditions. The necessary transformers are furnished by the Alabama Power Company.

While the uncertainties of this plan will not justify the construction of additional transmission lines, it will afford very material help in assisting the power companies to tide over a season of unusually low water. For several weeks, the War Department has been advised, it has been necessary for steam plants in Alabama to make up a power shortage in Georgia. Had the Corps of Engineers been permitted to go forward with its original plan of a temporary lease, arrangements would have been made to put more of the power into distribution. As it is the capacity of the transmission line will carry little more than the output of one generator. Under that arrangement some $2,000,000 would have been returned to the treasury during the period of eighteen months.

Water Hammer Ruptures Moccasin Penstocks

It is reported that excessive pressure rise resulting from improper operation of a gate valve at the Moccasin power house of the city of San Francisco caused the rupture of two penstocks on June 30. An inexperienced operator failed, it is said, to open the by-pass valve before opening a large gate valve at the power house end of one of the penstocks. The water hammer set up by the sudden rush of water under a static head of 1,316 ft. through the short section of empty pipe between the gate valve and the water wheel caused the immediate breaking of one of the penstocks about 4,000 ft. from the power house. About fifteen minutes later a second break occurred in one of the other penstocks some distance from the power house.

To account for this very unusual happening it is said that with the penstock arrangement at this plant it is possible that a series of pressure waves might build up that would gradually get sufficiently out of phase to cause an excessive surge in one of the penstocks. The Moccasin plant has four lap-welded steel penstocks leading down the slope to the power house. Each penstock branches into two pipes, containing gate valves, before entering the power house to the double overhung water wheels. The two penstocks that broke were 66 in. in diameter at the point where the rupture occurred.

The total damage estimated by the city engineer's office is about $10,000. In addition to the damage to the penstocks themselves there was some damage done to the power house from mud and water washed down the hillside. Single sections of pipe will be used to repair the damage to the penstocks and it is expected that the plant will be ready for operation within two weeks.

Rebuilding of Santa Barbara Planned

Measures Taken to Finance Reconstruction Immediately—Southern California Edison Will at Once Construct Quarter-Million Dollar Substation Planned for 1926

ATTACKING the problems of reconstruction with all the vigor of true pioneers, the citizens of Santa Barbara have made splendid progress in the task of removing every trace of the devastating quake which killed fourteen persons and caused a property loss of approximately $13,000,000. Actual damage was confined almost entirely to the business district of the city, the residential section suffering comparatively little. The danger of fire from short circuits made it necessary to prohibit the use of electricity in the stricken city until a thorough inspection had been made in all houses, but street lights in the business area were on at 7 p.m. the day of the shock. Emergency service to the two newspapers, one hospital, and one ice plant was available within a few hours after the quake.

According to official estimates, the Southern California Edison Company, which serves Santa Barbara with electricity, sustained a loss of approximately $15,000. The Santa Barbara sub-station building, which the company had planned to wreck in 1926 and replace with a modern station, was completely destroyed. All of the equipment of this station was of the out-of-door type with the exception of the motor-generator sets used to furnish power for the street railway. Aside from the breaking of a bushing on one of the transformers and the slight displacement of another, this outdoor equipment escaped injury. Temporary switches were erected back of the outdoor substation and new feeder lines connected to the distributing circuits, which were not damaged anywhere in town. Within the building the motor-generator sets received a shower of mortar and bricks but were found to be unharmed and ready for use after overhanging walls had been demolished.

APPEARANCE OF A STREET IN BUSINESS DISTRICT OF SANTA BARBARA AFTER EARTHQUAKE

Profiting by the work done for them by the earthquake in wrecking the old building, officials of the company decided to advance the date for starting the work on the new substation about one year, and the necessary appropriation of $250,000 was authorized immediately. An emergency crew of more than 100 men was sent to Santa Barbara and excavation work on the new site which the company had previously purchased at the corner of Gutierrez

and Quarantina Streets was started at once. The substation being built will not only be the terminal of the 60,000-volt lines from Saticoy substation, but will likewise be the distributing point for all light and power circuits supplying the city and its environs. The station will have a 60,000-10,000-4,000-volt transforming capacity, and both building and equipment will be of the most modern design and type.

The Santa Barbara & Suburban Railway, a subsidiary of the Southern California Edison Company, suffered slight damage and service was restored Saturday. It was necessary to set seventy-five poles on State Street to support the overhead trolleys, which were formerly supported by buildings damaged by the earthquake.

Iron and Steel Men Arrange September Convention

Starting with an informal luncheon at noon on Monday, September 14, the annual convention of the Association of Iron and Steel Electrical Engineers, which is to have headquarters at the Benjamin Franklin Hotel, Philadelphia, will continue through to Saturday of that week. Tuesday's program will cover oil-circuit-breaker practices in connection with high-tension switching, and on Wednesday "frog-leg" armature windings will be the topic. The electric heating committee will report on Thursday, its subject being "From the Ingot to the Finished Material," and a complete review of the application of electricity for heating purposes in the steel industry will be made.

"Auxiliaries and Auxiliary Drives for Steam-Electric Generating Stations" will be the subject of a paper prepared by the superintendent of power stations of a large electric light and power company, and another paper of timely interest will be entitled "Extending the Heat Cycle in Boiler Operation by the Use of Preheated Air for Combustion."

The usual manufacturing exhibit will be made. Monday evening there will be an informal dance, and on Thursday evening the annual banquet will take place. The Philadelphia Section will have charge of the entertainment.

Middle West Utilities Acquire Central Power & Light

The Middle West Utilities Company, of which Martin J. Insull is president, has announced that it has purchased the total outstanding common stock, consisting of 50,000 shares of no par value, of the Central Power & Light Company from R. W. Morrison and Warner S. McCall of St. Louis. The Central Power & Light Company operates directly in Arkansas and through subsidiaries in Texas, Oklahoma, Kansas, Mississippi and Mexico serving sixty-five communities with electric light and power, gas, ice, water, or electric railways. Natchez, Miss.; Laredo, Corpus Christie and the Rio Grande Valley in Texas are among the larger districts in which electric service is furnished. The properties taken over have total assets of approximately $15,000,000, annual gross earnings of more than $5,000,000 and serve more than 40,000 customers.

The company is said to have shown great progress during the last year from a viewpoint of physical condition and increased earning power.

Transmission in France

All Systems of 60,000 Volts and Over Are Shown in a Chart Issued by the Government

THE French Ministry of Public Works has issued a chart showing the electrical high-tension lines (including those of 60,000 volts and over) in operation and under construction in France on January 1, 1925, as well as those for the construction of which governmental authorization has been granted or requested. The most important hydraulic and fuel-burning electrical plants in that country are indicated.

EXISTING AND PROJECTED HIGH-TENSION LINES IN FRANCE AS OF JANUARY 1, 1925

According to electrical development as indicated on the chart, of which an analysis has been made by Wilson K. Ray, assistant trade commissioner with the United States Consulate, French territory can be divided into seven regions—north, northwest, east, central east, central west, southeast and southwest. Mr. Ray's analysis is as follows:

North.—This district receives its electrical power almost exclusively from fuel-burning plants.

Northwest.—This section is one in which very little electrification has taken place and no high-tension lines are in existence.

East.—A large amount of electrical power is consumed in this industrial section of France. The high-tension lines indicated on the chart connect the fuel-burning plants of the region. Some hydro-electric power is obtained from Switzerland.

Central East.—In this region the high-tension lines are charted as tying up the hydro-electric plants of the Alps and of the Massif Central with the large fuel-burning plants of the Paris section. Lines also run to the mining and industrial regions of St. Etienne and Creusot.

Central West.—The lines in this section join certain hydro-electric plants of the Massif Central with fuel-burning plants of the region between Bordeaux and Nantes.

Southeast.—Plans which call for development in this section are not far enough advanced to be shown on the chart. It is intended to tie up plants using hydro-electric power available in the Southern Alps with fuel-burning plants at St. Tulle and Lingostière, as well as those using power derived from reservoirs which are planned to be constructed at Verdun and Tinée. A high-tension system of 120,000 volts which will join these different sources of electrical power and be incorporated in the electrification plan of the Paris, Lyons & Marseilles Railroad is now under consideration.

Southwest.—The high-tension systems shown in this section are those joining the hydraulic plants of the Pyrenees and of the Massif Central section. The electrification of the Midi Railway is an important factor in this section of the country.

Investigation Continues

General Electric Company Receives Further Attention from Federal Commission

THE investigation of the General Electric Company is being continued actively by the Federal Trade Commission, newspaper reports to the contrary notwithstanding. The commission has come to the conclusion that it may investigate whether or not the General Electric Company monopolizes or controls, in restraint of trade, the production and distribution of electric power, or the sale of electrical equipment and apparatus. Funds were appropriated to the Federal Trade Commission for use during the fiscal year, which began July 1, with the proviso that no money could be expended for an investigation requested by a single house of Congress. This limitation, however, was not to apply when the investigation request deals "with alleged violations of the anti-trust acts."

In that connection the opinion has been expressed that a resolution by one house would have to make a positive allegation that the anti-trust statutes had been violated. The commission, however, takes the view that the Senate itself does not have to make such an allegation, but that it is sufficient if the allegation is made on the floor of the Senate.

This means that the investigation will be carried on actively from this time forward, perhaps more actively than would have been the case had there been no limitation on the appropriation bill. That proviso reduces the number of investigations which the commission can undertake and thereby makes available more money for those which are to be undertaken.

The commission is in doubt as to a portion of the work which it had begun before the expiration of the last fiscal year. That portion of its investigation has as its objective the establishment of whether or not the General Electric Company resorted to propaganda intended to influence the people against public ownership. That portion of the work was stopped on June 30, pending a report from the Attorney-General as to whether or not it is precluded by the appropriation act proviso.

U. G. I.-American Gas Merger Now Before Commission

The approval last week by a special meeting in Philadelphia of the stockholders of the United Gas Improvement Company of the merger of that concern with the American Gas Company will make the union of the two companies, already ratified by the one last named, complete as soon as the Pennsylvania Public Service Commission shall have sanctioned it. The American Gas Company controls the Luzerne County Gas & Electric Company, which, with headquarters at Kingston, Pa., is now erecting a 40,000-kw. steam plant in the center of the anthracite region; the Langhorne (Pa.) Electric Light & Power Company, the New Hope (Pa.) Electric Company, the Philadelphia Suburban Gas & Electric Company and the Burlington Light & Power Company in Vermont. Its former Iowa properties—the Cedar Valley Electric Company of Charles City and the Citizens' Gas & Electric Company of Waterloo—together with other companies in the Hawkeye State, have already been consolidated by the United Gas Improvement Company into the Central Iowa Power & Light Company (see ELECTRICAL WORLD, June 6, page 1228). The United Gas Improvement also owns the Sioux City Gas & Electric Company in that state. It has a large interest in the Connecticut Light & Power Company of Waterbury, the Counties Gas & Electric Company of Pennsylvania, the Syracuse (N. Y.) Lighting Company, the Charleston (S. C.) Consolidated Railway & Lighting Company and other central-station concerns.

Hylan Fights Power Mergers

Corporation Counsel of the City of New York Files Brief with Public Service Commission Attacking New York State Mergers—Says Utilities Plan Selfish Monopoly

STRESSING the point that the proposed power mergers now being undertaken in New York State are the parent units of a system which will ultimately involve the public utility companies of several of the Eastern states, the brief in behalf of the city of New York, filed July 8, in the matter of application of the Buffalo, Niagara & Eastern Power Corporation to acquire more than 10 per cent of the common stock of the Buffalo General Electric Company, the Niagara, Lockport & Ontario Power Company, the Tonawanda Power Company and the Niagara Falls Power Company, calls upon the Public Service Commission to deny all such applications until a definite state policy has been evolved.

The brief is divided into thirteen points of argument and is signed by George P. Nicholson, corporation counsel of New York City; M. Maldwin Fertig and Joseph P. Morrissey of counsel.

In Point IX the brief states: "The history of the powerful light and power companies of the state of New York is the familiar story of mergers, purchases and agreements of companies for the purpose of destroying competition and upholding prices. From small beginnings these companies have grown and grown until today their tentacles stretch out to the very borders of the state and beyond. Within their grasp are many power sites which rightfully belong to the people of the state and should be operated by them through their chosen servants. . . . Gradually our natural resources are being gobbled up and centralized in a few powerful corporations, while the people of the state are being charged high prices for power and light. The Public Service Commission should call a halt on such mergers and also help the people to retain what remains of their natural resources.

"While this application is to take over the stock of the operating companies," states the introduction to the brief, "it is nevertheless the first step in an enormous superpower merger which eventually will take in all the electric companies in New York State from Buffalo to Montauk Point and perhaps others in Massachusetts and Pennsylvania.

"At the hearing in Albany on June 23, the attorneys of both the Buffalo, Niagara & Eastern Power Corporation and the Mohawk Hudson Power Corporation stated that it was only a matter of a short time when they will apply to the commission for leave to merge the companies which they now seek to purchase."

Point I of the brief emphasizes that this application may make a precedent which would affect the citizens of New York City.

In Point II of the brief the contention is set up that the proposed purchase of stock is in violation of Section 7 of the Clayton (anti-trust) act of October 15, 1914, Chapter 323. The purchase of power from Canadian companies is cited and it is pointed out that "If these operating companies do not already send electricity into Pennsylvania and Massachusetts, they will do so in a very short time. They will also purchase power generated in those states by coal and transmit it into this state. That is part of the plan in the eventual merger of the power companies of this state. This interstate and international business brings these companies within the provisions of the Clayton act.

"Furthermore," says Point II in conclusion, "after the big merger takes place and when the question of rates arises the company may well set up the contention that the Public Service Commission has no jurisdiction because the business is interstate. If the commission allows this sale to be made, it will aid in the violation of a law of the land which it is sworn to uphold."

In Point III it is contended that this purchase of stock would do an injustice to the present owners and future investors. "The fundamental defect in this proposal," says Point III, "is the doubling of the capital stock and the issuance of it without regard to the fair value of the properties entitled to a return. This will inject a speculative element into the securities which has an unhealthy influence on the operation of the properties and subjects the investors to unjustified losses in the future."

OPPOSES INCREASED CAPITALIZATION

In Point IV it is declared that "This purchase of stock contemplates no benefit to the public and more than doubles the stock. In effect there will be floated by the new company one or more shares of preferred and one or more shares of common stock for every share of stock of the present companies now outstanding. What facts disclosed to the commission in this proceeding would justify such an increased capitalization? . . . Does this commission wish to lend itself to this stock scheme, allow this company to double its capitalization and mislead the investing public?

Regardless of the par value of the new shares, the public still considers and always will that even stock of no par value is $100 in value. You have no control over Wall Street, but you have control over public utilities. Will you exercise it in this instance?"

SAYS STOCK IS MANIPULATED

Two examples of alleged stock manipulation in the companies proposed to be merged are cited. The Buffalo General Electric Company recently converted its stock into shares of no par value on the basis of five shares of the new stock for one of the old (page 8 of the Buffalo, Niagara & Eastern Power Corporation petition).

Under the terms of this projected purchase each of the present shares will be converted into one and one-tenth shares of the preferred and one and one-tenth shares of the common stock of the Buffalo, Niagara & Eastern Corporation. Thus the holder of one share of the original Buffalo General Electric Company will be the owner of eleven shares of the stock of the Buffalo, Niagara & Eastern Corporation.

"The large bulk of stock buyers, outside of the professional traders, do not investigate the history of the stocks they buy and will not know when buying a share of the Buffalo, Niagara & Eastern Corporation that it represents only one-eleventh of a recent share of the Buffalo General Electric Company. Has the value of that old stock increased to such an extent?"

The other example cited is that of the Tonawanda Power Company. Here the brief states:

"The preferred stock of that company was increased from 34,700 shares in 1921 to 44,700 shares; in 1923, the stock was increased to 53,500 shares and in 1924 it was again increased to 112,200 (page 102 of minutes). That is an increase of more than 205 per cent in the number of shares in three years.

"The holders of 38,200 shares of the common stock of the Tonawanda Power Company will under this proposed plan receive 95,500 shares of the preferred and common stocks of the Buffalo, Niagara & Eastern Power Corporation (page 8 of the petition of the Buffalo, Niagara & Eastern Power Corporation). In other words, a holder of a share of the Tonawanda Power Company stock will receive two and one-half shares of the stock of the petitioner herein, which is an increase in his present holding of 150 per cent.

"Should not the investing public be protected from such manipulation of securities?"

ATTACKS APPRAISAL VALUES

In Point V the brief points out that the commission during the short time in which the application has been pending has been unable to make a thorough investigation of the value of the plants. "The day has long passed since the appraisal of a public utility company by its own officials and agents could be taken without careful checking by the authorities," says the brief.

Point VI contends that this sale would completely stifle competition.

"The large stockholders of these four operating companies are men of wealth and influence in the northern part of this state, and some of them are directors in a number of banks. Thus they wield an enormous influence. Cases have been known recently where such influence has been used against men who dared fight them in protecting their ownership in water-power property. So it is that competition by men of small means is completely stifled through the fear that their credit in the banks will be impaired and the mortgages on their property foreclosed.

"As one instance of the interlocking interests of these 'power barons' in banks, it may be pointed out that the Northern Power Corporation controls the Northern New York Trust Company. But that is only one bank. Other similar instances could readily be found if the commission would look into the matter."

In Point VII it is contended that "The stage is being set for a big public utility clean-up. The *American Gas Journal* recently published a statement saying: 'From January 1 to April 30, 1925, stocks and bonds of public utility stocks were traded in on the Stock Exchange to the amount of $5,000,000 per day, Sundays and holidays excluded.'

"That is one indication," says Point VII, "of the public utility clean-up that is being made this year. That, together with the way those stocks have been boosted in price, shows that the stock is being unloaded onto the public, who will be left holding the bag for a long time to come.

"After the stocks go down the public will get tired of holding them and the old owners will pick them up again at the rock bottom price. Stock quotations at the present time should put the commission on its guard to the end that it should refuse its permission to this proposed purchase."

In Point VIII various public officials and people are quoted as being in opposition to the granting of the petition. The speech of Mayor Hylan is quoted at length, the platform of the national Republican convention at Cleveland in 1924 in relation to the preservation of natural resources from exploitation, and the various messages of Governor Smith on state regulation, control and development of hydro-electric energy.

ADVOCATES STATE USE OF RESOURCES

In Point X the argument is advanced that the natural resources of the state should be preserved for the citizens thereof. The brief states on this point in part:

"The movement is already on foot by large electrical companies and power combinations to send into the coal fields of Pennsylvania the power generated at Niagara, in the St. Lawrence River and in the Adirondacks. Thus will be presented the spectacle of throwing apples into an apple orchard. . . . The developed and undeveloped millions of Niagara horsepower are to be linked to the developed and undeveloped million and a half horsepower of the Albany district. That district has already been linked to the power of the New England waterfalls and tidewater steam plants, driven by steam. Thus part of our natural resources will be developed and sold in New England instead of to our own citizens. . . .

"A new power transmission line is to be built this year southward from the Albany district to the very edge of the New York-Pennsylvania line. Thus again some of the natural waterpower of the state of New York will be developed, conveyed and sold in another state where coal is plentiful and cheap, while the citizens of the city of New York will continue to pay exorbitant rates for electric current generated in steam plants from coal conveyed here at high traffic rates from Pennsylvania."

ASKS STATE DEVELOPMENT OF ST. LAWRENCE

In Point X the methods of the Adirondack Power & Light Corporation are attacked and a plea for state development of St. Lawrence River power is set up.

"Among the large electrical combinations doing business in this state is the Adirondack Power & Light Corporation. That company includes a dozen or more consolidations of corporate interests. The welding of such a group of systems into one corporate ownership is inconsistent with public policy. It was necessary to devise a plan whereby a community of corporations might seem to exchange power supplies on the basis of cheapest development of power.

"There is a vast amount of cheap hydro-electric power on the St. Lawrence River, too much for one corporation to handle. If that power were developed and transmitted to New York City, the largest power market, the citizens of that city would be able to save a vast amount of money that is now spent on electricity furnished by steam generation plants.

"In its propaganda, the Adirondack Power & Light Corporation sets forth a fantastical proposition for the exchange of that nature-bestowed power for the expensive current generated in the steam-driven plants of New York City. By that method they are striving to overcome the prejudice against combinations. A close study of their claims and plans will convince the commission that the alleged benefits to consumers are but a myth and a delusion.

"If a private corporation can convey electricity from the St. Lawrence River to the citizens of New York City, why cannot the state do it as well? As citizens of that city they pay the majority of the state's expenses and consequently should participate in the natural resources of the state.

"For several years the Adirondack Power & Light Corporation has preached the doctrine of interconnection and power interchange between systems as part of its propaganda to sing the people to sleep while their natural resources are being taken from them. That company is one of a group of six of the largest power companies of the East that have their heads together planning through the pretence of interconnection problems to grab most of our natural resources. The entire New England group, the Metropolitan New York group and the Niagara, Lockport & Ontario Power Company are some of the others in the scheme.

"They are laboring day and night for a centralized power plant and a monopoly of the electricity of the state.

The 'public-be-damned' policy that has always characterized power development is still alive and rampant.

"It is the bounden duty of the Public Service Commission to put a stop to the granting of any more of our natural resources and to preserve zealously the nature-given electricity of our state to the inhabitants thereof. There is no time like the present to adopt that policy, which should be continued until the state develops its own resources for the benefit of its own citizens."

In Point XI, the brief tells of the action of the state of Maine in refusing to permit electricity generated there to be transmitted into other states for sale. Point XII cites an extract from a speech of Governor Pinchot of Pennsylvania delivered at St. Paul, Minn., on June 30 in which he warns the people to watch electric groups.

"The commission should not pass upon this application until the Attorney-General has been consulted and his opinion obtained."

The brief above cited was filed by the corporation counsel of the city of New York intervening against the proposed merger as a matter of right under the provisions of the public service commission law.

Government Dam in Ohio River May Be Raised

Dam 41 in the Ohio River at Louisville probably will be raised 8 ft. with a decision in the matter expected in the near future. If this is done it will eliminate the need for building proposed dam 40 at Madison, Ind., 50 miles up stream from Louisville. The increased height will create a pool extending for 75 miles. The dam, however, will be flooded out at periods of highest water, an average of forty-five days a year.

The improvement will permit the generation of 3,300,000 kw.-hr. annually. The Louisville Hydro-Electric Company holds a preliminary permit from the Federal Power Commission covering the development and has pending an application for license.

The work on the dam will be done by the corps of engineers but the Hydro-Electric Company will build the power house. Two working seasons will be required for the construction work.

Copco No. 2 Plant Placed in Operation

Formal dedication ceremonies witnessed by 2,000 customers, stockholders, business men and bankers marked the opening of the Copco No. 2 hydro-electric plant of the California Oregon Power Company on July 5, 1925. People coming from all sections of southern Oregon and northern California were the company's guests at a luncheon served following the opening ceremony. The plant, which represents an investment of $4,000,000, is located on the Klamath River in northern California, about a mile below Copco No. 1 plant of the same company and a few miles south of the California-Oregon border.

Two 20,000-hp. turbines, operating under a head of 140 ft., drive two 15,000-kw. vertical-type generators. A large proportion of the output of the plant will be sold to the Pacific Gas & Electric Company under a long-term contract. Besides a transmission line tying the plant in with the California Oregon system, there is a 77½-mile, 110-kv. single-circuit, wood-pole transmission line connecting with the lines of the Pacific Gas & Electric Company at Delta, Cal.

Cherokee Rating Increased

Alabama Power Company Will Complete Tallapoosa River Project in 1926

THE Alabama Power Company expects to complete the initial installation of the Cherokee Bluffs hydro-electric project on the Tallapoosa River by the end of 1926. The original plans called for an initial installation of 90,000 hp., with an ultimate capacity of 180,000 hp., but the company now plans to install three 45,000-hp. units immediately.

Cherokee Bluffs is a storage project as distinguished from the company's "run-of-the-river" plants on the Coosa River. The 150-ft. dam will impound 530,000,000,000 gal. of water, covering 40,000 acres of land. This storage will help greatly in regulating the Tallapoosa and the Alabama River into which it flows and in preventing floods. A 4-ft. depth of navigable water will be maintained by this regulation from Montgomery to the Gulf and navigation on the artificial lake will open up territory that is not reached by railroad. Agricultural experts say that the impounding of the lake will make a large territory to the south of the lake frost-proof and will make possible the cultivation of many kinds of fruit with a minimum of danger.

Cherokee Bluffs will make unnecessary excessive reserve steam power, since it will have water enough in storage to take most of the load of the "run-of-the-river" plants when their stream flow is at a minimum.

North Central Convention to Be Held at Duluth

From Wednesday, July 15, through Friday, July 17, the North Central Geographic Division of the National Electric Light Association will hold its annual convention at the new Hotel Duluth, Duluth, Minn. The program prepared for the convention includes an address by J. E. Davidson, president of the N. E. L. A. on "Public Relations," and a session devoted to a symposiunf on rural electrification during which Dr. E. A. White, chairman of the N.E.L.A. committee on relation of electricity to agriculture; G. C. Neff, chairman of the rural service committee, and other experts identified with this movement will speak. The business sessions on Thursday and Friday afternoon will be devoted to papers which will cover all phases of the electrical industry. Wednesday will be occupied by registration of members and a trip in the afternoon to near-by power stations. The entertainment program is well-balanced and inclusive of all forms of recreation for members and their families.

Succession to O. C. Merrill Canvassed at Washington

Dr. F. H. Newell, F. E. Bonner, Paul S. Clapp and Herman Stabler are being mentioned at Washington in connection with the vacancy which will be created when O. C. Merrill resigns as executive secretary of the Federal Power Commission. Those who look with favor on public ownership are said to have put forward Dr. Newell's name. He was connected with the Reclamation Service from 1902 to 1914, first as chief engineer and later as director. He is a past-president of the American Association of Engineers and has been connected prominently with educational work and the public service. While Dr. Newell has been an advocate of public ownership as a theoretical ideal, he favors only limited application of the principle in practice, and he will have support from others than the proponents of public ownership.

Mr. Clapp has been an active opponent of public ownership of electric utilities. He is a young man, but his ability is widely recognized. Mr. Clapp was graduated in 1913 from Iowa State College with a B. S. degree in electrical engineering and entered the service of the Western Electric Company at its Chicago factory. From February, 1914, to February, 1917, he served the Western Electric Company in its engineering department in New York. He did research work on the vacuum tube and had an important part in the inauguration of transcontinental telephony. He held responsible posts for the United States government during and after the war.

Mr. Bonner, who is a district engineer of the Forest Service with headquarters at San Francisco, has been mentioned as one who has had long experience in the handling of water-power matters for the government. One-third of the Federal Power Commission's projects are in his district.

Mr. Stabler, an engineer in the service of the Geological Survey, has had wide contact with the problems which come before the commission. Until the creation of the commission the Land Classification Branch was the agency in the Interior Department that handled all matters related to the issuance and supervision of permits for water power use of public lands, and for several years Mr. Stabler had responsible charge for the department of this work, which has later been handled by the commission. He has been closely associated with the work of the Geological Survey related to the administration of the federal water-power act, was the representative of the Interior Department in the preparation of the first draft of a plan of procedure under this act and is familiar with the practice of the Federal Power Commission as it has been developed. He knows intimately the literature and other sources of information pertaining to the power problems of the country. Mr. Stabler is of the judicial type, a clear and mature thinker and a forceful speaker and writer.

Briefer News

Amherst (Va.) Plant Acquired by Lynchburg Traction & Light Company.—The plant and distribution system of the Amherst Light & Power Company have been purchased by the Lynchburg (Va.) Traction & Light Company at a price announced as $14,500. Amherst will be served from a transmission line and the local plant will be closed down.

Davenport Station Goes Into Operation.—The new 25,000-kw. Riverside plant of the United Light & Power Company near Davenport, Ia., described in the ELECTRICAL WORLD on April 11, 1925, page 787, was placed in operation on July 2. The initial installation cost was approximately $3,000,000 and will supply power for Davenport, Rock Island, Dubuque and adjacent territory.

Madrid (Ia.) Company Changes Hands.—The purchase of the Madrid Light & Power Company by the Iowa Railway & Light Corporation has been approved in the district court at Boone. The property was sold for $45,500 by the Mayor of Madrid, who acted as receiver when the owners of the company became involved in legal disputes.

Completion of Rhine Canal in Alsace Will Make It Possible to Develop 800,000 Hp. — The Rhine Commission (Germany being unrepresented) has unanimously approved the projected completion of the Rhine canal in Alsace between Kembs and Strasbourg. This will give a new navigable waterway north and south on French soil and will, it is said, make available 800,000 hp. of the Rhine flow. The plan is to build an electric power house at each of the eight important locks.

Municipal Project Abandoned When Utility Offers Service.—The City Council of Wild Rose, Wis., has dropped proceedings to take over the property of the Rose Milling Company, which has supplied light and power to the town, since the Wisconsin Power & Light Company has arranged to take over the plant and give the town service from a transmission line. The Council felt that better service would be given by the utility.

Insull Interests Acquire Beloit (Wis.) Utility. — As foreshadowed in the ELECTRICAL WORLD of May 23, the Northwest Utilities Company has announced the acquisition of the Beloit Water, Gas & Electric Company. The Northwest Utilities Company is a subsidiary of the Middle West Utilities Company, which is controlled by Samuel Insull and his associates. The transfer also included subsidiary companies of the Beloit property which serve territory adjacent to Beloit and, while no financial details were made public, the Wisconsin Tax Commission lists the value of the properties involved at about $2,000,000. Although plans had been completed for an extension to the generating station prior to the transfer, it is rumored that an interconnection will be made with the Wisconsin Power & Light Company, another subsidiary of the Middle West Utilities Company.

Wisconsin Water-Power Law to Be Tested.—A test case which is attracting attention in water-power circles in Wisconsin is the suit of the Middle Dam Power Company of Appleton before the State Supreme Court to compel the Railroad Commission to grant the company a permit to rebuild its dam without making it subject to the recapture clause of the Wisconsin utilities act, which allows the state the right to buy public utility water-power projects at a fair valuation thirty years after the development is completed. The commission, it is understood, has refused to strike out the recapture clause from the permit.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see ELECTRICAL WORLD, July 4, page 50.]

East Central Division, N. E. L. A.—Breakers Hotel, Cedar Point, Ohio, July 14-17. D. L. Gaskill, Greenville, Ohio.

North Central Division, N. E. L. A.—Duluth, Minn., July 15-17. H. E. Young, Minneapolis General Electric Co., Minneapolis.

International Association of Municipal Electricians—Hotel Statler, Detroit, Aug. 17-20. W. R. Arbuckle, Bayonne, N. J.

Wisconsin Utilities Association, Electric Section—Green Bay, Wis., Sept. 4-5.

Camp Co-operation V (local leagues)—Association Island, Henderson Harbor, N. Y., Sept. 8-12. (Society for Electrical Development, New York, is sponsor.)

New England Division, N. E. L. A.—Hotel Griswold, New London, Conn., Sept. 8-11. Miss O. A. Bursiel, 149 Tremont St., Boston.

Pennsylvania State Association of Electrical Contractors and Dealers—Hotel Jermyn, Scranton, Sept. 10. M. G. Sellers, 1202 Locust St., Philadelphia.

Rocky Mountain Division, N. E. L. A.—Hotel Colorado, Glenwood Springs, Col., Sept. 14-17. O. A. Weller, 900 15th St., Denver.

Association of Iron and Steel Electrical Engineers—Benjamin Franklin Hotel, Philadelphia, Sept. 14-19. John F. Kelly, Empire Bldg., Pittsburgh.

Southeastern Geographic Division, N. E. L. A.—Birmingham, Sept. 15-18. E. T. O'Connell, Alabama Power Co., Birmingham.

Great Lakes Geographic Division, N. E. L. A.—French Lick Springs, Ind., Sept. 23-26. R. V. Prather, 305 Illinois Mine Workers' Bldg., Springfield, Ill.

Association of Electragists International—West Baden, Ind., Sept. 23-25. L. W. Davis, 15 W. 37th St., New York.

American Electrochemical Society—Chattanooga, Tenn., Sept. 24-26. Colin G. Fink, Columbia University, New York.

Empire State Gas and Electric Association—Lake Placid Club, N. Y., Oct. 1-2. C. H. B. Chapin, Grand Central Terminal, New York.

American Electric Railway Association—Atlantic City, N. J., Oct. 5-9. J. W. Welsh, 292 Madison Ave., New York.

National Association of Railway and Utilities Commissioners — Washington, D. C., Oct. 13-16. J. B. Walker, 270 Madison Ave., New York.

Electric Power Club—Briarcliff Manor, N. Y., Oct. 19-22. S. N. Clarkson, B. F. Keith Bldg., Cleveland.

Austria Gets $18,000,000 to Electrify Railroads.—The finance committee of the League of Nations has released $18,000,000 from the League's loan to Austria to be used for the electrification of the Austrian railroads. The government originally asked for $25,000,000. The money is to be used to electrify the Tyrolean railroad from Salzburg to Brudenz and the Brenner line. This railroad connects Austria with Italy and Switzerland and is most important from a commercial and tourist viewpoint.

Progress of Illinois Central Electrification.—The Illinois Central Railroad Company has spent more than $25,000,000 on suburban electrification to date, it is officially announced, and more than $37,000,000 will be needed to complete the project. Operation of the trains is predicted on July 1, 1926, six months ahead of the ordinance requirement of the city of Chicago.

Leipzig Technical Fair to Be Held in September.—All branches of the German electrical industry will be represented by exhibits at the Technical Fair to be held at Leipzig, Germany, from August 30 to September 9. The German manufacturers at this time display their latest developments in all types of equipment, including motors and generators, transformers, insulating material, electric railway equipment, measuring instruments, small farm plants, and industrial machinery.

Quebec Municipalities Indorse Premier in Opposition to Power Export.—Unqualified approval of the policy of Hon. L. A. Taschereau, Premier of the province, in opposing the export of Quebec's hydro-electric power, was expressed in a resolution adopted at a convention of the Union of Municipalities of the Province of Quebec. The concluding sentence of the resolution read: "The members of this convention indorse and support firmly the attitude of the Premier on this question."

H. M. Byllesby & Company Purchase Two Western Companies.—The purchase of local plants at Douglas, Wyo., and Falls City, Ore., has been announced by H. M. Byllesby & Company. The Falls City plant was municipally owned and will now be served by a transmission line from Dallas, Ore.

Michigan Rural Service Line Completed.—The experimental rural service line undertaken by the Consumers Power Company near Parma, Mich., has been completed. It extends six miles and serves twenty-six representative farms of varying sizes, as well as two schools, one being of the newer modern design with electric equipment, and a rural church. The line will be operated in conjunction with the Michigan State College of Agriculture and Applied Science, under the direction of which the research will be conducted. A point that will receive especial consideration, according to Vice-President B. C. Cobb of the Consumers Power Company, is the relation of the design of farm machinery to the high-speed electric motors now in use, with ratings of 1,200 r.p.m. and 1,800 r.p.m.

Work Started on Largest Dam in Japan.—Preliminary work has been started on the Otaki Dam on the Kiso River by the Great Consolidated Electric Power Company (the Daido company). The 300-ft. dam will be one of the highest in the world and with a storage of 73,500 acre-feet the project will be the largest in Japan. The Daido company has recently completed new contracts with the Tokyo Electric Company to dispose of the power from the eleven hydro-electric plants to be completed on the Kiso River and will soon build a new 154,000-volt transmission line to the Tokyo and Yokohama districts.

Merchants' Company Gets Park-Lighting Contract in Indianapolis.—A contract for lighting Indianapolis parks and boulevards for the next ten years has been let by the Board of Park Commissioners to the Merchants' Heat & Light Company. The city engineer, who tabulated the two bids received, said the Merchants' Company's figure was $11,000 a year lower than the bid of the Indianapolis Light & Heat Company. The Merchants' Company has the present contract.

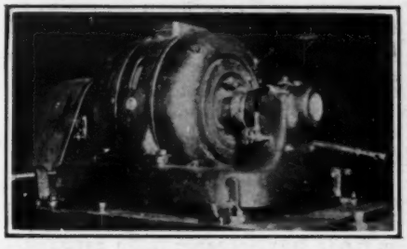
Water Resource Report Suggests Power Generation.—In a report on the water resources of California filed with the 1925 Legislature it is stated that with 400-ft. dams on the upper Sacramento, the Feather and Yuba Rivers and a 300-ft. dam on the American River three billion kilowatt-hours of electrical energy could be generated annually prior to the full use of these reservoirs for domestic, irrigation or industrial use. In the main the report deals with the importation of water for irrigation in certain sections of the interior valleys where the supply of ground water is nearing exhaustion.

Pasadena Municipal Plant Goes to Gas as Fuel. — The Pasadena (Cal.) municipal light and power department is installing gas burners under the boilers in the steam plant to replace the oil burners now in use. Since natural gas can compete very favorably with fuel oil at $1.18 or more per barrel it is expected that this change will save the city thousands of dollars annually. The Los Angeles Gas & Electric Corporation has contracted to furnish one year's supply of natural gas and is speeding up work on a pipe line to carry this fuel to the city station. Consumption will approximate 3,000,000 cu.ft. of gas per day.

Broad River Power Company Merger Completed.—The Broad River Power Company, subsidiary of the General Gas & Electric Company, has acquired, in accordance with plans previously announced, the electric and gas properties and franchises of the following South Carolina companies: Columbia Gas & Electric Company, Parr Shoals Power Company, South Carolina Power Company, Columbia Gas Light Company, Central Carolina Power Company and the Public Service Company of South Carolina. The merger was made possible under an act of the last session of the South Carolina Legislature. The Broad River Power Company, as previously reported, has created an extensive power system centering around Columbia and is building a main steam generating station on the Broad River at Parr Shoals.

Illuminating Engineers to Meet at Detroit.—The nineteenth annual convention of the Illuminating Engineering Society will be held at the Hotel Statler, Detroit, during the week of September 14-18. The program now being arranged includes sessions devoted to motor-vehicle lighting, natural lighting and residential lighting. Other subjects to be discussed will be high-intensity industrial lighting, show-window lighting and floodlighting computations.

Continuous Operation for Twenty-Nine Years.—The first electric motor installed by the Southern Pacific Railroad was purchased in 1896. This motor, shown in the accompanying illustration, is still running after twenty-nine years of service. It is a 10-hp.,



1,200-r.p.m., 60-cycle, 440-volt, three-phase, sleeve-bearing machine built by the General Electric Company. Since its original installation it has performed various tasks, driving lathes, slotters, punches, shears, etc., all with continuous service in the company's main shop at Sacramento, Cal.

Power Corporation Acquires Three Up-State New York Companies.—The Power Corporation of New York announced last week that it had acquired control of the Malone Light & Power Company, the Fort Covington Light, Heat & Power Company and the Milling & Lighting Company of Brasher Falls. All these companies are in the northeastern part of New York, generate electricity by water power and will eventually be connected by transmission lines to the Power Corporation system.

Electric Control for Hothouses. — Botanists at the Wisconsin Agricultural Experimental Station of the University of Wisconsin, in their experiments to determine the effect of temperature and humidity on the growth of plants, are controlling heat and moisture by using electric solenoids and contactors. The amount of moisture is controlled by a "humidistat," which operates a General Electric solenoid. This in turn controls a damper in a pipe through which air is forced by a small motor-driven blower. In the experiments it is necessary to vary the temperature. This is done by means of a thermostat which operates a General Electric contactor. Each contactor controls four 250-watt luminous radiators. The application of this equipment is unique, and it is estimated that the university saves at least 50 per cent of the first cost of the control apparatus as compared with the initial cost of other control which it had been using with moderate success.

Staten Island Hails Newly Electrified Railroad.—Staten Island, which forms one of the boroughs of Greater New York, took a half holiday on July 1 to celebrate the operation of the first electric train over the Perth Amboy division of the Baltimore & Ohio Railroad between St. George and Tottenville. Electrification of the old Staten Island steam railroads has cost about $7,000,000 thus far and will be carried out gradually on all steam lines on the island.

More High-Tension Lines for Southwest Oklahoma.—Sixty-four miles of high-tension transmission line will be constructed in southwestern Oklahoma immediately under the plans of the Southwestern Light & Power Company, Earl R. Ernsberger, president and general manager, has announced. Four new cities will be reached by the lines, which include 7½ miles from Tipton to Headrick, 28½ miles from Temple to Grandfield, 10½ miles from Temple to Hastings, 10 miles from Hastings to Waurika and 7½ miles from Grandfield to the city waterworks. This construction program will bring the company's high-tension mileage up to 273. It has headquarters at Lawton.

Canadian Engineer Estimates Dominion's Available and Unavailable Water Power. — Henry Holgate, a Canadian hydraulic engineer, writing in the Montreal *Gazette*, says the estimate of the Dominion Water-Power Branch that Canada's recorded water-power resources will permit of a turbine installation of 41,700,000 hp., while probably correct, gives an exaggerated picture, because it includes water powers in Labrador, around Hudson Bay and in the far North. "Of the 18,255,000 continuous horsepower available in Canada," says Mr. Holgate, "at least 11,440,000 hp. is in what is now undeveloped country where water power is of no value owing to the lack of demand. In the commercial section of Canada we have a total of 6,815,000 hp., of which 3,569,000 hp. has already been developed, or 53 per cent of the available water power of commercial value."

Expansion in South Dakota.—It is stated by G. A. Stevens, vice-president of the Northern Power & Light Company of Mobridge, S. D., which was recently organized to take over the Mobridge Electric Company, serving Mobridge, Glenham and Selby; the Boyle Electric Company, serving Gettysburg, the Dakota Utilities Company, serving Eureka; the New Era Power Company, serving McLaughlin, and the Sheets Electric Company, serving Lemmon, all in South Dakota, that the company expects to purchase additional properties in the central part of that state, and interconnect them with high-tension lines.

Men of the Industry

J. B. Miller New Vice-President of N. E. L. A.

John B. Miller, who was elected a vice-president of the National Electric Light Association at the recent convention in San Francisco, has been a conspicuous figure in the development of the electrical industry in the West for the past twenty-seven years. His association with utility interests in California dates back to 1897, when he affiliated himself with the electric light and power business in Los Angeles. During his long and useful career he has brought to successful completion gigantic undertakings. These have culminated in the present Southern California Edison Company, which he now heads as president.

J. B. MILLER

Mr. Miller was born at Port Huron, Mich., in 1869 and received his education at the Ann Arbor High School and the University of Michigan. He spent six years in his native state and Louisiana before going to California in 1896. In 1901 the Edison Electric Company was formed out of the merger of the West Side Lighting Company and the Redlands Electric Light & Power Company, and Mr. Miller became president. Eight years later, when the company was reincorporated under the name of the Southern California Edison Company, Mr. Miller was elected president of the new organization, assuming the duties of chairman of the board in addition in 1918. Mr. Miller has a wealth of interests besides those connected with his executive position in the Southern California Edison Company, being an officer and director in many other industrial enterprises.

Fielder I. Hiss, formerly of the Crocker-Wheeler Company, has joined the organization of the Triumph Electric Company of Cincinnati as chief engineer and assistant to the sales manager. Mr. Hiss has had a long and varied experience in the motor field. Born in Baltimore, he was educated abroad. Having been graduated from Finsbury College of London, England, in 1902 as an electrical engineer, he immediately entered the industry as assistant to Silvanus P. Thompson and later was designing engineer for Johnson & Phillips of London. Returning to this country in 1906, he became associated with the Westinghouse Electric & Manufacturing Company of East Pittsburgh, where he was engaged in development work in the railway power and industrial division until 1913. In the latter year he joined the Crocker-Wheeler Company as assistant chief engineer, becoming assistant to the late Schuyler S. Wheeler and finally manager of its small-motor department.

F. A. Merrick, who became vice-president and general manager of the Westinghouse Electric & Manufacturing Company early this year, has been made a director of the company to succeed the late A. G. Becker.

Alex Dow, president of the Detroit Edison Company, has been appointed a member of the Board of Water Commissioners by Mayor John W. Smith to fill the vacancy caused by the death of Commissioner Edward S. Reid. Mr. Dow has served several years on the Water Board and resigned during the administration of former Mayor James Couzens. His present term will expire March 1, 1926.

E. F. W. Alexanderson, consulting engineer of the General Electric Company, whose high frequency alternator has made trans-oceanic radio communication possible, was decorated by King Gustav V of Sweden on July 2 with the Order of the North Star, the highest decoration within the power of the King to bestow upon scientific or distinguished persons. The decoration was part of the ceremony in connection with the official opening of Sweden's new high-powered radio station at Varberg. Two of the Alexanderson alternators are installed in this station. Mr. Alexanderson will return from abroad on the *Leviathan,* reaching New York on July 20.

Otto Snyder, general superintendent of the Adirondack Power & Light Corporation, Schenectady, N. Y., has recently been appointed manager of power resources. Mr. Snyder became associated with the Adirondack company in 1917 when it was under the management of Stone & Webster. Later when Stone & Webster relinquished control he remained with the Adirondack company, engaging in the study of rates and other commercial activities. In 1921 he was appointed general superintendent in charge of all engineering, construction, plant operation, transmission and all matters pertaining to power supply. Mr. Snyder will continue these duties under his recent appointment.

B. C. J. Wheatlake, manager of the central-station department of the General Electric Company at Denver, has been appointed to succeed Robert Miller as local manager of that company at Salt Lake City, Utah. He started work with the General Electric Company in 1910, spending approximately one year on the test course and one year in transformer designing, going to the Denver office of the company in 1912. For the last ten years Mr. Wheatlake has been very much interested in the activities of the American Institute of Electrical Engineers. He was president of the local section at Denver three years ago, and has twice represented the Denver section as delegate to the national convention. While in Denver he took a very active interest in the Electrical Co-operative League and also the Rocky Mountain Committee on Public Utility Information.

F. D. Avis Heads Michigan Association

Floyd D. Avis, secretary and general manager of the Southern Michigan Light & Power Company, Hudson, Mich., was elected president of the Michigan Electric Light Association at the recent annual convention of the association at Mackinac Island, Mich. Mr. Avis has been associated with the

F. D. AVIS

Southern Michigan Light & Power Company since 1916 and has been particularly successful in building up the electric range load in the fifteen towns served by his company. For ten years prior to 1916 he represented the Electric Appliance Company throughout Michigan. In state utility work, Mr. Avis has taken an active part, having served several years as either a director or an officer of the Michigan Electric Light Association and now serving on a state committee appointed to study the problem of farm electrification.

W. E. Phin has been elected president of the Dominion Power & Transmission Company, Hamilton, Ontario, to succeed Col. J. R. Moodie, who resigned.

Elwood Blass has been appointed chief engineer of the Fort Smith (Ark.) Light & Traction Company to succeed E. Ryan, recently made commercial manager.

E. Ryan, formerly chief engineer of the Fort Smith (Ark.) Light & Traction Company, has been appointed commercial manager of the company.

C. S. Nason, manager of the Lake Superior District Power Company at Medford, Wis., has been appointed public relations manager to succeed Donald C. Slichter, resigned.

Arthur F. Little, who has been an assistant in the export department of the Bryant Electric Company, Bridgeport, Conn., has been appointed export

manager of the company. Mr. Little is a graduate of Dartmouth in the class of 1923 and of the Amos Tuck School of Administration and Finance.

Anson W. Burchard, vice-chairman of the board of directors of the General Electric Company, sailed for Europe July 3 aboard the White Star Liner *Majestic.*

R. B. MacGuinness, formerly connected with the Central Hudson Gas & Electric Company, Poughkeepsie, N. Y., has been appointed operating superintendent of the United Hudson Electric Corporation and its subsidiary companies. The United is controlled by the Central Hudson organization.

Harold Evans has been appointed to membership on the Pennsylvania Public Service Commission.

A. C. Cornell of Denver, one of the organizers of the Electrical Co-operative League, was named by the advisory board to head the league as chairman during the next fiscal year.

Bryant White, general superintendent of the electric light and power and gas departments of the Lynchburg (Va.) Traction & Light Company, has resigned to join the Wilmington & Philadelphia Traction Company at Wilmington, Del.

L. H. McClure, formerly of the service department of the Johns-Pratt Company, Hartford, Conn., has been appointed assistant to the general sales manager, D. G. Phelps, and in his new work will assume duties formerly devolving upon the late Robert Charles Cole.

C. J. Allen, formerly of the accounting department of the Connecticut Light & Power Company, Waterbury, and **Albert S. Jourdan,** formerly district superintendent of the company, with headquarters at New Britain, have been appointed executive assistants at the general offices of the company in Waterbury.

C. I. Davis, who has been connected with the valuation division of the Public Service Company of Northern Illinois since January, 1924, has been appointed valuation engineer to succeed O. E. Sinclair, recently promoted to the position of engineer of electrical distribution construction.

Charles S. Brewer of Herkimer, N. Y., has been elected chairman of the board of directors of the Mohawk-Hudson Power Corporation, according to an announcement made by Charles S. Ruffner, president of the corporation. The new chairman is president of the Standard Furniture Company of Herkimer, a graduate of the St. Lawrence University, and he has spent his entire business career with enterprises operating in the Mohawk Valley.

R. V. Rosenbaum, who has been in Aberdeen, Wash., since May, 1924, in charge of certain construction work for the Grays Harbor Railway & Light Company, has removed to Springfield, Mo., where he will supervise new work in that city. Mr. Rosenbaum is engineer and supervisor of the plants of the Sanderson & Porter Company and was sent to Aberdeen when the Federal Light & Traction Company, with which the Sanderson & Porter interests are identified, prepared to install a new power unit.

L. C. Bradley President of Stone & Webster Virginia Properties

Stone & Webster, Inc., Boston, Mass., announces the following changes in the executive personnel:

Luke C. Bradley has been appointed division manager and has taken charge of the Virginia properties as president thereof with headquarters at Richmond. Southwestern district matters will be handled by the district office directly with Boston.

A. Stuart Pratt and **C. F. W. Wetterer** have been appointed general executives of the operating division. They have full charge of that division, including operating division departments in the Boston office.

Harry T. Edgar, division manager, has taken charge of the Northern New England and Cape Breton properties in addition to the Middle West, Southern New England and Insular properties which have been under his charge for some time. The two New England districts are to be combined.

Donald C. Barnes has been appointed division manager of the Southeastern properties and the Sierra Pacific Electric Company. He will continue his present position in connection with the Northwestern properties.

M. L. Sperry, in addition to the Southern New England and Insular companies, which he has been handling as district manager for some time, has taken over the properties of the Northern New England district and Cape Breton.

George H. Clifford has been appointed district manager in charge of the Southwestern district.

Stone & Webster also announce the following changes in managing executives of companies under its executive management.

William E. Wood, formerly manager of the Houston Electric Company and Galveston-Houston Electric Railway, has been elected vice-president of the Virginia Railway & Power Company in charge of operations.

J. F. McLaughlin, formerly manager of Baton Rouge Electric Company, has been elected vice-president of the Virginia Railway & Power Company in charge of new business.

Jefferson L. Alexander, formerly manager of the Haverhill Gas Light Company, has been appointed manager of the Houston Electric Company and Galveston-Houston Electric Railway.

Walter H. Burke, formerly manager of the Houghton County Electric Light Company and Houghton County Traction Company, has been appointed manager of the Northern Texas Traction Company and Tarrant County Traction Company.

J. Alves Dixon, formerly general superintendent of railways of the El Paso Electric Company, has been appointed manager of Baton Rouge Electric Company.

C. W. Koiner, City Manager of Pasadena, Cal., has resigned to establish offices in Los Angeles as a consulting electrical engineer. Mr. Koiner has been intimately connected with the electric light and power business since 1892, when he joined the Laurel (Md.) Electric Light, Power & Heat Company. In 1905 he went to St. Louis as secretary-treasurer and engineer of the National Light & Improvement Company, a holding company controlling a number of gas and electric utilities throughout Kansas and Texas. Moving to California in 1908, Mr. Koiner engaged with the City of Pasadena as general manager and electrical engineer of the city's light and power utility. His appointment in 1921 as first City Manager of Pasadena was the logical culmination of his excellent record in the city's service.

Obituary

Roy Edward Shawlin, for the past six years affiliated with the Russell & Stoll Company, New York, died on June 26 in his forty-first year as the result of appendicitis. Starting as manager of the Chicago office, Mr. Shawlin served for two years in that capacity before removing to New York as sales manager, the position he occupied at the time of his death. Formerly, Mr. Shawlin was identified with the Westinghouse Lamp Company, with the business staff of the ELECTRICAL WORLD and just previous to his connection with Russell & Stoll with the Franklin Lamp Company. He was a native of Ottawa, Ill.

E. E. Hunter, superintendent of distribution of the Warren division of the Ohio Public Service Company, died June 18, following an operation. Mr. Hunter became affiliated with the Doherty organization in 1914 after being graduated from the Mississippi Agricultural and Mechanical College. His connection with the Ohio Public Service Company dates back to 1922, when he entered its service as electrical engineer, later being promoted to the position of superintendent of distribution. Mr. Hunter was thirty-two years of age.

J. R. Portnell, superintendent of the electrical distribution department of the Union Electric Light & Power Company, St. Louis, Mo., died suddenly on July 2 at St. Luke's Hospital, Duluth, Minn. Mr. Portnell was thirty-nine years of age.

Albert E. Winchester, for thirty-three years superintendent of the South Norwalk Municipal Electric Works in Connecticut, died on June 29 in the Littleton Hospital, Littleton, N. H. Mr. Winchester was born in Marietta, Ohio, fifty-eight years ago and became a pioneer in the field of electrical engineering with the first organization under Thomas A. Edison. He was a charter member of the American Institute of Electrical Engineers and served a number of times on national boards. Mr. Winchester was sent to England at one time by the federal government to investigate municipal lighting plants in that country. In Norwalk, Conn., he served on many boards and assisted the Public Utilities Commission. In 1897 Mr. Winchester designed the municipal plant in South Norwalk, and he was its superintendent at the time of his death.

Recent Court Decisions

Death of Lineman from Ruptured Artery Ascribed to Electric Shock.—The Supreme Court of Michigan, in Dean vs. Benton Harbor-St. Joe Railway & Light Company, upheld a decision by the State Department of Labor and Industry that the death of a lineman from a ruptured artery was caused by electric current from wires near which he was working, though no marks of an electric burn showed on his body. The evidence showed that the lineman, who had previously been raising a heavy pole, was at the time of his death working on a pole within a few inches of high-voltage wires. The post-mortem found that he had died of a rupture of a "hardened" artery, and no one saw him touch a wire before his death. The court held that since the heavy work he had been doing had not caused his death, the fatality must have been due to an electric shock rather than the light work he was then engaged in. Three of the members of the court dissented from this opinion, saying that there was no evidence to show that electricity had played any part in his death. (203 N.W. 952.)*

Profitable Light and Power Service and Unprofitable Street Railway Held to "Stand or Fall Together."—The South Carolina Supreme Court, in City of Spartanburg vs. South Carolina Gas & Electric Company, ruled that the company could not cease operation of an unprofitable street railway and continue profitable electric and gas operations when all the divisions were operated under one franchise. The company contended that the street railway could operate only at a loss because of lack of patronage and that forcing such operation constituted confiscation of property. It further contended that the Railroad Commission of South Carolina had exclusive jurisdiction over its operation, though prevented by the state law from adjusting rates specified under the franchise, and that the commission had authorized discontinuance of the railway provided the company instituted a satisfactory bus service to replace it. The court held, however, that the franchise and ordinance under which the company operates constitute a binding contract including all services, that the Railroad Commission has no power to authorize suspension of any public utility service, and that neither the courts nor the commission can arbitrarily substitute one service for another in a binding contract. "The electric light and power business is linked to its electric railway business," the court declared. "The respondent admits that its electric light and power franchise is valuable and it is a paying business. If the street railway does not pay with all the advantages it derives from its light and power adjunct, then an electric railway alone must fail. It is inevitable that Spartanburg must be without a street railway if the respondent be allowed to keep the one and destroy the other. They stand or fall together as an entire contract." Two of the five members of the court dissented from the opinion, saying in substance that the police power of the state was sufficient authority for the commission to authorize the suspension and substitution of bus service and that to force combined operation at a loss was confiscation. (125 S.E. 295.)*

Principles of Valuation Again Laid Down.—In determining the present fair value of the property of the American Indian Oil & Gas Company for rate-making purposes, suit having been brought against the company by the city of Poteau, the Supreme Court of Oklahoma laid down the principle that neither original cost nor reproduction cost new, considered separately, is determinative, but consideration should be given to both original cost and present reproduction cost less depreciation, together with all the other facts and circumstances which would have a bearing upon the value of the property, and from a consideration of all these a fair present value is to be determined. The court declared further that in a proceeding instituted before the Corporation Commission by the utility company for the purpose of establishing a rate to be charged by it for the service rendered it was incumbent upon the utility company to establish the fair and reasonable value of its property in public service at the time. (235 Pac. 906.)*

Knowledge of Danger Does Not Alone Constitute Contributory Negligence.—The Supreme Court of New York, Appellate Division, ruled in Shindler vs. Sullivan County Light & Power Corporation that if an individual is killed or injured by contact with an electric wire while attempting, in a careful and cautious way, to prevent escaping electricity from setting fire to property, his mere knowledge of the danger from the electric wire does not constitute contributory negligence. During a storm of wind and lightning one of the power company's lines came into contact with a bell wire running between two adjacent houses, and it was alleged that this accident was due to faulty construction of the service line. The owner of the houses noticed that the two wires were entangled in a tree which they set on fire. In order to prevent the fire spreading to the houses, and with full knowledge of the danger from the electricity, he stood close to the bell wire and threw a hatchet at it, hoping to cut it or to disentangle it from the power line. The bell wire broke off about 25 ft. from where he stood and fell on him, causing his death. The court ruled that he had taken proper precautions and would not have been killed under ordinary circumstances and that the entanglement of the wires was due to the faulty condition of the power company's lines. One member of the court dissented from the opinion because he believed that the victim was not justified in going near the wire since there was no life endangered by the accident and no immediate danger to the houses. (209 N.Y.S. 562.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Municipality Authorized to Raise and Equalize Rates.—The Wisconsin Railroad Commission authorized the Black River Falls Electric & Water Utility, municipally owned, to raise and revise its rates in order to make up for a loss it was suffering. The principal increases in rates were in street lighting and municipal power and to one large power consumer. Energy in all these cases had been supplied at rates far below the switchboard cost of power. The commission pointed out that the electric department should stand on its own feet and should not give special and unjustified rates to any city department or consumer.

Municipal Utility Ordered to Serve Township Where Plant Is Situated.—In issuing an order requiring the Eagle River Light and Water Commission, a municipal utility, to extend its electric service to the town of Cloverland, the Wisconsin Railroad Commission has decided that a municipal utility must serve a township in which its hydro-electric generating plant is situated. The commission said: "The water-power plant of the Eagle River Light and Water Commission is in the town of Cloverland, in which place the Eagle River Commission objected to serve patrons. The electrical energy generated and transmitted to the distribution systems of the Eagle River utility is located there. These transmission lines run not only to Eagle River, but across and through the town of Cloverland to Minocqua, where service is also rendered. The poles and wires are located in the public highway across the town of Cloverland by virtue of a local permit or franchise granted by the Town Board of Cloverland. The Eagle River commission contends that this franchise so far as it relates to the extensions to serve patrons in the town of Cloverland is permissive only and that it may not be required to serve such patrons against its wishes. The reason it objects to serving patrons in Cloverland is that its water-power plant, which under the present arrangement is exempt from taxation, will be subject to taxation if local service is rendered in Cloverland, and that the revenues derived from the few patrons which can be secured in Cloverland will be entirely out of proportion to the amount of taxes which it will be required to pay upon this plant. On the other hand, the residents of Cloverland cannot understand why they should be deprived of electric service simply for the reason that the water-power plant happens to be located in their own town. What would seem normally to be a natural advantage of their own in possessing a hydro-electric development has become, by virtue of a peculiarity of the public utility taxation law, an actual disadvantage, not only depriving the town of the taxes from the water-power property but also depriving it of service from the plant."

Manufacturing and Markets

Merchandising Appliances

Problem Requires Careful Consideration—Manfacturers Should Continue to Improve products

"MERCHANDISING of all kinds of commodities from the farm and factory to the consumer is the most important economic and social problem before the world today," said Edward N. Hurley, chairman of the board, Hurley Machine Company, Chicago, speaking at the forty-eighth convention of the N. E. L. A. at San Francisco on June 16. Continuing, Mr. Hurley said that manufacturers of appliances have $350,000,000 invested in plants and equipment, the securities of which are owned by people who believe in the electrical industry, the same as utility customers who believe in and invest in utility securities.

"The sale of securities on the customer-ownership plan has been most successful in communities where the largest percentage of homes are using electrical labor-saving appliances," said Mr. Hurley. "The central-station companies in the state of California, which introduced customer-ownership, found that their residential customers not only had confidence in the management of the lighting companies, but on account of their experience in using appliances in their homes were doubly convinced of the safety of the securities and the future of the electrical industry. Research, inventions and engineering have been improved and developed to a phenomenal degree in the central-station field, and now we are at the threshold of the commercial era.

"Central-station companies are receiving in current revenue from home appliances used on their lines $266,000,000 annually. If the appliances that are producing this revenue could be increased 20 per cent, the central-station companies of the country would receive in current revenue, most of it on the off-peak load, from the use of these additional appliances, $54,000,000 annually, making a grand total of $320,000,000 revenue from appliances, or 6 per cent on more than $5,000,000,000 of the total amount of $7,000,000,000 now invested in public utilities in the United States. The large majority of the central-station companies that are selling electrical appliances have demonstrated by proper merchandising methods that a substantial net profit can be made on the products they sell, without taking into consideration the current-revenue-producing feature, and their efforts are now directed toward improving their merchandising methods.

"The problem of merchandising the products of our country is not one for the electrical industry alone, but it affects our whole economic structure of business and government, and if we are to improve our merchandising methods we must give this important subject that careful consideration which the present situation demands. There is a very strong co-operative spirit on the part of many central-station companies toward their local dealers, in encouraging them to increase the sales of electrical home appliances of standard quality. This splendid spirit, displayed in many localities, has resulted in large sales of appliances, by both the dealers and central-station companies, yielding substantial merchandising profits to each, as well as permanently increasing the house appliance load.

PHASES OF DISTRIBUTION

"There are undoubtedly three phases in the distribution of any product: First, the pioneer period, when the manufacturer is endeavoring to interest any type of outlet that he can obtain to handle the product, and what he is interested in primarily is reaching a certain volume so that he may attract a broader market with a better price. After he has demonstrated the need for an article, such as the automobile, washing machine, phonograph, radio, and it is profitable, then all types and kinds of wholesalers and retailers immediately clamor to handle the article and the demand is in excess of the supply. This is the speculative boom period—with the inevitable over-production. Naturally, this period does not obtain for considerable length of time, and the third phase entered is the period of stabilization, advertising and selling, which means a careful selection of wholesalers and a selection, also, of the retail outlets as well as advertising mediums.

"In the distribution of electrical products, no doubt many have endeavored to apply the same methods in the distribution of a 'specialty' where the inventory investment was high as has been used in the sale of a 'convenience' article. An analysis of the type of electrical product, and a study of the best methods for handling that product, will assist the larger electrical manufacturers today in maintaining a larger share of the market than they hold at present. The question of servicing appliances must be considered seriously by manufacturers, as it not only affects the future sales of their particular product, but if prompt local service is not readily forth-coming the unfavorable reaction is likely to be against the entire industry.

"When a piece of electric merchandise is sold, the seller and buyer realize that at some time it may have to be serviced. It is different from 98 per cent of the articles used in the home. When the purchase is made of a central-station company or electrical dealer, there is a feeling of satisfaction on the part of the buyer that should the article require service it will receive the attention of experienced men who know all about electricity. This feeling, naturally, does not always exist when the purchase is made of non-electrical merchants. In building for tomorrow, manufacturers of appliances used in the home should continue to put forth every effort to improve their present products and invent and perfect new labor-saving devices so that when they are sold they will give satisfactory use for years."

Reducing Losses in Pioneering

Better Co-operation Between Manufacturers and Central-Station Companies Will Cut Down Preventable Wastes—Systematic Field Data Vitally Needed

BY "OBSERVER"

AMONG the problems of commodity distribution which perplex the electrical industry, one of the most important is the allocation of responsibility for pioneering new products, the acceptance of that responsibility and the co-operation of those who share in it to minimize wastes and speed up efficiency of applications. Electrical devices vary widely in their technicality, and so in their ease of application. The closer they approach a staple classification, the simpler becomes their production, sale and use and the sooner the pioneer period ends. It is of fundamental economic importance to pass out of that period as soon as possible.

The losses of the pioneer period are well known and need not be detailed. In the electric light and power industry device after device has been designed, produced in small quantities, marketed and applied in increasing numbers until its success has done away with the need of pioneering except as embodied in relatively small though nationally valuable improvements which have not affected the fundamental usefulness of the product. The electric flatiron and the induction motor furnish two of the most striking examples of this evolution known to the industry. Many other products have long since reached the established class of reliable commodities, and still more are on the way. In general, the losses associated with pioneering center about the relatively small initial demand for new products, which makes their manufacture and sale expensive per unit, and about insufficient industry-wide knowledge of their performance in the earlier installations.

Some of these losses can unquestionably be reduced if manufacturers and distributors, including for the present

discussion central-station companies, begin to co-operate even before the device takes shape in material form. There is a laudable tendency today to call the operating man into conference more than ever before when a new generating plant is projected, and in like manner the advice of the man who is to distribute and sell a new product to the general public may well be sought by the designing engineer of the manufacturer to a greater extent than is at present practiced, before the drawings of the new device go to the foundry and the shop, and again, before the preliminary units leave the test room and shipping department for the first commercial installations. The designing engineer, it is true, may reject the advice of the sales agency; but if he does so, it is with open eyes and a full realization of the responsibility involved. The main thing is that these two shall get together early enough in the game to insure full consideration of the various angles of the problem of marketing the new device. That these angles differ widely every one will concede who has had opportunities to observe closely the time and "grief" often required to stabilize a product and weed out its defects as revealed in the grueling test of commercial service.

More Field Data Needed

More systematic field data are vitally needed by manufacturer, jobber and retailer in order to shorten the pioneering period with its relatively high overhead and comparatively small demand. While the manufacturer is waiting for the hour of mass production to strike, one of the best investments he can make is in increasing his contacts between factory and field through traveling, correspondence, compilation of service data, interchange of experience with the jobber and central-station company, and a general effort to coordinate all available information about failures of the product in service, its performance under abuse, the reasons why the ultimate purchaser likes it or is opposed to it, the economic analysis of old against new methods, and the suggestions of the man in the field in conference with the designer as to possible lines of improvement.

Too often new devices are thrown upon the market in a careless way without provision for thorough note-taking of their applications and behavior. The press of other duties keeps the central-station man or other retailer from adequate follow-up work, and, again, poor records of servicing jobs are kept, if any. It is far more important for the time being to follow up the new device closely than to devote executive attention to routine production and sales work, and in just so far as all parties co-operate to gather and analyze field experience for the common benefits, so will the day of stabilization be hastened. It should not be forgotten that a temporary increase in clerical labor and supervision of new products in service will yield enormous dividends in time saved in getting devices into mass production and standard demand. It is time to concentrate more vigorously upon individual performance records in pioneer devices and "play closer together" in assembling charts, forms, data and analyses for group study in eliminating causes of trouble, raising efficiency in service and lowering preliminary costs as well as hastening the arrival of the day when mass production and sales will be feasible, with all that this means to manufacturer, distributor and consumer.

Milestones in Illumination

Absolute Primary Standard of Candlepower Proposed—Levels of Illumination Intensity Increae

BETTER and more intensive applications of light mark the chief developments in illumination during the past year, according to the A. I. E. E. committee on production and application of light. Three per cent more large incandescent lamps were sold in 1924 than in the year previous. Although marked improvements have been made in lamp manufacture, attended by several reductions in prices, present-day illuminants are still far from the scientific ideals of efficiency. Since last year, when the ring filament came into prominence, there has been a tendency to warp the filament to increase the horizontal component of light. New applications of incandescent lamps have increased the number of special types, and in consequence engineers have been studying means of standardizing a few types. Remarkable research effort has culminated in a proposal for an absolute primary standard of candlepower. This is based on the light emitted by a platinum fuse just at the melting point.

Strong Demand for Larger Units

Increased activity has been shown in store-window lighting, colored light and spot lights making merchandise more attractive. Strong artificial illumination of show windows is being used in the daytime to minimize the effect of external reflections. A strong demand for 300-watt and 500-watt units indicates an increase over the former popular size of 150 watts.

Industrially, the "glassteel" unit and various forms of opal and prismatic globes are finding great favor, although the steel dome is still most common. Levels of illumination intensity are increasing, and there are prospects of an industrial lighting co-operative campaign this fall. Unfortunately, the endeavor to increase lighting intensities is handicapped by inadequate wiring and insufficient outlets in some cases, but effective campaigns, such as the "Red Seal," are an offset to this obstacle.

About 15 per cent more equipment was used for new street-lighting installations and replacements last year. The trend is still toward ornamental units. Two-lamp units have been used extensively, although single and higher-power units would be more economical because the cost of service does not increase as fast as the volume of light. Asymmetrical lighting is meeting with considerable success. Extensive experimental studies are being made in several cities. Flashing traffic beacons and traffic-control signals are being installed in increasing number, the latter being synchronized and extended outside congested centers.

Trade Association Cases

Petitions for Rehearings Do Not Challenge Principles Laid Down in Recent Court Decisions

IN ANNOUNCING his intention to file petitions for rehearings in the Maple Flooring and Cement Manufacturers' Protective Association cases, the Attorney-General made it clear that he is in no way challenging the principles laid down by the court, but simply is attempting to show that there was violation of law in these particular instances. The Attorney-General's statement follows:

"Petitions for rehearing in these cases are in course of preparation and will be presented to the Solicitor-General within a few days. Leave was granted by the Supreme Court to file such petitions within thirty days.

"The object of the petitions will not be to obtain a reconsideration of the principles of law annunciated by the Supreme Court in its recent decisions, but to point out that the evidence in these cases brings them within prior decisions of the Supreme Court the authority of which has not been questioned. In other words, the government will not take the position that the Supreme Court erred in holding that the mere collection and dissemination of trade statistics is in itself unlawful, but will endeavor to point out that the evidence in the records shows that both the Maple Flooring Association and the Cement Association were co-operating in the use of such information for the purpose of maintaining prices. The whole effort will be to show that the evidence leads irresistibly to the conclusion that the defendants, through their associations, had agreed to maintain prices and otherwise restrain trade within the prior decisions of the Supreme Court in the hardwood lumber and linseed oil cases."

Bureau of Standards Director Approves Lamp Simplification

A SIMPLIFIED line of incandescent lamps would be a most important step in further improving the lighting of American homes, declared Dr. G. K. Burgess, Director of the Bureau of Standards, Washington, after examining a new composite type inside-frosted "mazda" lamp. The lamp is the first unit in a sweeping simplification program planned by the "mazda" lamp manufacturers and which was announced in a previous issue. The many types of lamps now being produced obviously prevent the most efficient and economical manufacture," said Dr. Burgess, "and I am heartily in accord with a program of simplification in this industry, which affects the people as a whole so directly. The future progress of American business depends largely on simplification and standardization of manufactured products. This will bring additional comforts and conveniences within the reach of the more moderate income. The production of a simplified line of incandescent lamps should prove a most important step in further improving the lighting of American homes."

Planning Vacuum-Cleaner Sales from Regional Headquarters

BY STICKING to the fundamentals of sales organization a record-breaking selling season is forecast by W. G. Keay, sales manager of the Boston district for the Eureka Vacuum Cleaner Company. Mr. Keay states that an increase of three thousand sales each year has been achieved. In summing up the working of his organization Mr. Keay says:

"We have a simple but close-knit, compact organization; we have faith in our product, and we have the will to get down to hard work and stick to it. Here is the A B C of selling. First, our regional organization may be likened to the make-up of a military unit. It cuts down duplication, needless overlapping, and tends to concentrate each member upon a definite charge or assignment.

"Let us choose any city, or town, or group of towns. We call that a district and appoint a supervisor to take charge; he is then a kind of sergeant. Each district is canvassed for the number of wired houses, and this number is blocked off into five thousand house units, over which are assigned district managers, or 'corporals,' and two men, 'privates' or solicitors. Thus the military analogy is carried out. Just as the private is the real cog in military action, so our solicitors are the cogs that turn our machinery. We see to it that these men are carefully chosen and that they are well informed concerning the mechanism of our product, not only as to the construction and assembly of parts, but also regarding proper operation and maintenance. With this equipment, and backed up with a knowledge of what our records show to be actual cash returns, we send them out.

"While formerly we had dull seasons, when the sales curve showed deep valleys or dips, we now have general uniformity. We have steadily impressed the fact upon our men that any season is really a selling season so far as we are concerned. We offer special encouragement at times, to be sure. We have prize contests, bonuses, and hold out opportunities for advancement into supervising positions. And under our system of organization, every 'private' knows that he has the chance to 'mount the grade,' if he has the will. In this way we have built up our selling organization. At no time is our force disrupted. Conferences, of course, are necessary, but these are taken care of according to schedule. The district manager, or 'corporal,' has his two men; over these he has constant watch, and to these he gives advice, suggestions and encouragement. The district managers in turn report to the district supervisors, the district supervisors to the division managers, the division managers to the territorial managers, and so on up the line to headquarters.

"Success, of course, comes through precision in the selling organization. We have stuck closely to the correlation idea as expressed in the military unit, and we know that a smooth-running, close-knit system brings results. That is the reason why we can look forward to more than fifteen thousand sales in this district for the coming year."

Business Conditions

HEAVY purchasing of construction materials by central-station companies is reported in some sections of the country, while from other sections manufacturers state that the receipt of many inquiries for generating and substation equipment presage the placing of some large orders at an early date. One order placed covered substation equipment and amounts to about $350,000. Industrial plants are purchasing actively, and the volume of business from these sources is good. Several orders for wire and cable were placed although none were exceptionally large. An order for lead-covered cable received from an industrial plant amounted to about $30,000.

Estimates of the bookings of the Westinghouse Electric & Manufacturing Company for the quarter ended June 30 are between $40,000,000 and $45,000,000, and compares with $40,300,000 for the same period last year. Steel consumption is good, mill operations are higher than for the same period last year, and indications are for continued operation with purchasing likely to increase soon.

In New England the demand for industrial electric heating equipment is prominent, with several good contracts closed and further interesting business in prospect. Sales of general-purpose motors have been active in that district, and central-station buying in general is excellent. Purchasing of equipment by central-station companies is active in the New York district and several good inquiries presage further sales. Industrial plants in that territory are showing increased activity in industrial lighting. Activities of central-station companies in the Southeast are requiring a very satisfactory volume of construction materials, with the demand for poles and pole-line hardware particularly good. A sharp falling off in orders from other classes of buyers in that section is also reported. Purchases of construction materials continue an important factor in the Middle West, and buying by industrial plants is quite active with the volume of business increasing. On the Pacific Coast power companies placed several orders, and industrial buying, especially from oil, lumber and canning companies, has been good.

General Electric at 75 per Cent Capacity—Exports Gaining

ANSON W. BURCHARD, vice-chairman of the board of the General Electric Company and chairman of the board of the International General Electric Company, who sailed for Europe this week, stated that the company's plants were operating at 75 per cent of capacity, but that capacity had been considerably enlarged by increased efficiency, and that the $300,000,000 annual output today would have been full capacity for the plant five years ago. Mr. Burchard stated that he expected orders this year to be at least equal to those of last year, and also that foreign business is running about 50 per cent ahead of last year. He stated that he expected prices on electrical equipment to remain steady, as there seemed to be no occasion for either a rise or fall in labor or raw materials.

Stoker Sales Increase—Small Units Especially Active

STOKER sales during the month of March exceed the reported sales both in number and total horsepower for any month during 1924. There are about 2,000,000 kw. of stoker-fired central-station plants now under construction or going into operation in the United States (not considering the ultimate rating.) Manufacturers believe that there will be a continued demand for stokers for building up the efficiency of older plants. At present central-station orders are reported as a little slack, but there is some good prospective business. Industrial boiler-plant orders are reasonably active, and small stoker units are selling well. Inquiries covering that type of unit are not only larger in number but show more interest. Foreign business is dull with few and spasmodic inquiries except from France, where sales are fair.

There is a decided trend away from fuel-oil burning among central-station plants, which is helping stoker business. Stoker renewal sales are good. Manufacturers are making earnest efforts to convince stoker users that the best way to buy renewal parts is from the manufacturer and not from a local foundry, claiming that progress in stoker manufacturing leaves local foundries far in the rear. Manufacturers report that there are many developments in an experimental and research way going on at the present time with stokers which give even greater promise than the results being obtained to-day and which will tend further to increase the demand for stokers. Deliveries are good and apparently will continue so.

Exceptional Demand for Fans—Stocks Reported Small

MANUFACTURERS of fans report an almost unprecedented demand this year. Sales were very poor last year and all companies were well provided with factory stocks. The reports received from various companies are as follows:

1. The demand has been almost unprecedented, nevertheless we were in a position to take care of our trade because of liberal stocks which we had provided in our various warehouses and at our distribution points. Naturally, production will be rushed on certain sizes and types for which there has been the greatest call, and we feel reasonably certain that we can give the jobbers and dealers prompt shipments during the remainder of the season.

2. We have experienced an unusual demand for fans in the New York district. Our warehouse stocks have already been exhausted. We have good stocks here at the factory, however, to take care of any

demand that might be created. The indications are that the smaller sizes of oscillators are moving much better than the 12-in. and 16-in. sizes On the non-oscillating types the movement is not so good. Our experience has always been that when the hot weather is on the larger sizes of fans move first and then if the season continues steady the smaller sizes follow.

3. Our factory stock is at present almost entirely exhausted on one item and the entire stock is very low. Our volume for this time of year is almost without precedent, and if there is no decline in present orders we will soon be reduced to the point of only being able to ship upon the basis of day-to-day production.

4. The demand for fans beginning with the first week in June is the heaviest within our experience. We believe the demand was adequately met by all manufacturers and that they were able to replenish their stocks as the demand required.

5. Early in June there were very substantial movements of fans not only in the New York district, but in the Chicago district, and throughout the states east of the Mississippi and north of the Ohio rivers. In fact, the movement was one of the heaviest we have ever experienced in that territory at that time of the year.

6. The demand that we have experienced this year for fans in the New York territory is heavier than ever before. Practically speaking, the stocks have been wiped out north of the Ohio and east of the Mississippi rivers, including practically everything we had in stock at the works.

7. We have had a great demand for fans. Practically all of our branches sold out the available stock and also exhausted factory stocks, so that the only fans available are the daily production of the factory. This is being absorbed as rapidly as it is produced.

8. The demand for fans so far this season has been very good. The volume of factory stock in most sizes is very small.

Potential Market for Heating Appliances in Latin America

TROPICAL Latin America is very seldom thought of as a possible market for electric heating and cooking apparatus and appliances, but as a matter of fact, while the demand is spotty and varies considerably according to the interest shown by the central-station company, there is a growing appreciation of such appliances, according to R. A. Lundquist, chief electrical division, Department of Commerce, who has recently returned to Washington from a trip to Venezuela, Colombia, Central America and Mexico. In many cities in these countries the flat rate of charging often in effect is a serious handicap to the development of the use of appliances. However, in spite of all the drawbacks, the use of electricity for home purposes is increasing.

The demand for electric heating devices in Mexico, for example, varies with the location of the city and the interest displayed by the local central-station company in building up its load. As an indication of what can be done, one of the larger electric companies sold approximately 450 reflector-type heaters during a short cold spell. Considering the country as a whole, disk stoves and reflector heaters are probably the most popular electrical heating devices, apart from the electric flatiron. There is also a considerable demand for immersion-type heaters, and many cheap heaters of this type, with clay bodies, are made locally. In fact, one type of immersion heater has the element wound on a hardwood body. The largest cities in Mexico have well-organized electrical dealers, and with good co-operation from local central-station companies it is believed that a considerable amount of electrical heating device business can be done. In analyzing the possibilities in any of these Latin-American markets it must be appreciated that many of the countries are small and have limited populations and that furthermore the purchasing power of the average person is considerably below that of the average user of electricity in the United States. Nevertheless, there is a certain field which American manufacturers can well cater to.

Sales of Copper and Lead Increase —Prices Advance

THE demand for copper, lead and tin has been excellent and prices for all of these metals have advanced. Zinc, also, seems to be on the upward trend and to have definitely broken away from the 7-cent level, though domestic sales have been small. The copper market has been active for several days. The metal offered at 13⅜ cents, delivered, last week, Thursday, was quickly absorbed and on Friday 13⅜ cents was the ruling price in Connecticut, with 14 cents obtained in the Middle West. This level was generally maintained on Monday also, but on Tuesday, copper became rather scarce at 13⅜ cents for most any delivery, and 14 cents was generally quoted at the close of the day and on Wednesday. Business was booked in the Middle West as high as 14⅛ cents. The total volume of sales for the week has not been quite so great as that of two weeks ago but it has been substantial.

The American Smelting & Refining Company's contract price for New York lead continues at 8 cents. Most producers have found the market decidedly active since last week Friday, but it became a little quieter on Wednesday. Both consumers and speculators have been anxious buyers, and it is probable that much of the consuming demand is semi-speculative. This is indicated by purchases made a few days ago when the market was weak by interests which had declared that they were well covered for the next month or two. Two producers have done a particularly large business, mostly for July and August shipment. Galvanizers have bought zinc on a decidedly moderate scale and the same can be said for brass manufacturers. Since the holiday, tin buying has been on a good scale.

NEW YORK METAL MARKET PRICES

	July 1, 1925 Cents per Pound	July 8, 1925 Cents per Pound
Copper, electrolytic	13¾	14
Lead, Am. S. & R. price	8	8
Antimony	16½	19
Nickel, ingot	34	34
Zinc, spot	7.35	7½
Tin, Straits	56½	57¼
Aluminum, 99 per cent	28	28

Base copper price July 8, 1925, 16 cents.

Industrial Heating Apparatus Active in New England

SALES of industrial electric heating equipment are prominent in the New England trade. Two 30-kw. cyanide pot furnaces were sold to a New Britain, Conn., manufacturer and several special furnaces of about 60-kw. rating were purchased by Torrington, Conn., industrial companies. Orders from Massachusetts and New York States were also received in good volume. One manufacturer expected to close several contracts this week covering 200 kw. of furnace equipment. Electric heating apparatus sales are easily 40 per cent ahead of last year. Motor sales are very active in fractional horse-power sizes, with the demand diversified. One house reports its motor business for the first half of this year as about double the same period last year, with a dominant demand for use with pumps, air compressors and refrigerating machinery. Circuit-breaker and storage-battery sales are increasing over last year, the latter especially in the radio and automobile fields, with a most favorable outlook for the remainder of the year. Active preparations are in progress for fall campaigns in industrial lighting.

Central-station buying in general is excellent and with the exception of the textile industries all business shows an improving outlook. Many inquiries for electrical apparatus are reported as being received by manufacturers. These inquiries include generating units, water-power apparatus and an increased quantity of general-purpose motors. Jobbers report a colorless week with the smaller central-station companies buying equipment. Sales of fiber conduit and armored conductor were good. Irons, cleaners, washers and refrigerators are in active demand.

Central Stations Active—Other Orders Fall Off in Southeast

ACTIVITIES of central-station companies in the Southeast are requiring a very satisfactory volume of construction materials, with the demand for poles and pole-line hardware particularly good. One jobber recently received an order for creosoted pine poles amounting to $20,000. A sharp falling off in orders from other classes of purchasers was also reported by electrical jobbers. Carrier-current equipment is in good demand, one order for $25,000 and another for $20,000 having been recently placed. Manufacturers report several requests for preliminary figures for equipment entering into projected but not as yet announced hydro-electric developments in this territory, as well as satisfactory inquiries for transmission line materials.

The distribution of orders received from industrial plants is very spotty and the volume somewhat spasmodic. Municipalities are showing a reasonably satisfactory activity. There is a noticeable tendency on the part of municipalities to consider the installation of white-way systems and the revamping and enlarging of their present distribution systems, and inquiries in hand for this class of material are very good. In the supply lines, schedule material, wiring materials and wiring devices are reported as generally quiet, except in Florida, where the demand is very active. A contract for the installation of 40 electric ranges in an Atlanta apartment house is reported by a jobber this week. Lamp sales are good and dry battery orders are better than might be expected. The long spell of extremely hot weather has served materially to slow up all lines of retail trade, but the government's estimate that the 1925

cotton crop will be the third largest in its history and the generally satisfactory condition of other crops in the Southeast are having a stimulating effect on the rural population and the general outlook for the territory is bright.

Large Inquiries Presage Good Orders in New York District

MANUFACTURERS report that a number of large inquiries received from central-station companies in the New York district presage the placing of several good orders within the next two months. One company plans the enlargement of its generating facilities and is accordingly requesting a number of quotations for estimating purposes. One order placed this week by a central-station company covers substation equipment and amounts to about $350,000. Steady purchasing of transformers, switching equipment and pole-line material, but in small quantity, is reported by a utility company in upper New York state.

Several good orders for wire and cable were placed. One order from an industrial company for lead-covered cable amounted to approximately $30,000. Sales of general-purpose motors continue much better than for the same period last year. A motor manufacturer reports his sales in June as better than May and that the prospects for July are good. Fans continue to be much in demand and manufacturers' shipments are very quickly absorbed. Much activity is noticed in the demand for industrial lighting equipment. With the exception of irons, sales of which are very good, appliances are not in much demand.

Power Companies Buying Pole-Line Equipment on Pacific Coast

POWER company business on the Pacific Coast is marked by large purchases of pole-line hardware for Central Valley, Cal., points and a 400-pole order for the River Delta, Cal., district. An order was also placed by the lighting department of the city of Seattle for switchboard panels and instruments. Industrial business is excellent, especially from oil, lumber and canning companies. In addition, the extension of deep-water terminals along the Oakland waterfront has resulted in orders for considerable quantities of conduit, conduit fittings and steel reflectors. Contracting orders are good, and the hand-to-mouth buying spirit, which has prevailed since early spring, is apparently being overcome. School construction work around San Francisco is active.

The expected increase in the movement of electrical logging and lumbering equipment during the midsummer shutdown is slowly materializing. Increase in manufacturing and distributing facilities are included in a program announced by the Westinghouse Electric & Manufacturing Company, including the enlargement of its Seattle plant. Appliance sales are better, without any indication of a seasonal decline. Fan orders continue excellent and after a disappointing start a good fan year seems assured. A tremendous selling campaign on electric ranges has been announced for the central and northern California territory, with 6,000 ranges as the quota set to be sold during the balance of the year. The June, 1925, value of San Francisco building permits was $4,661,024, and compares with $3,899,374 for June, 1924. Seasonal crops have progressed sufficiently to indicate bumper quantities, and business in all the interior communities has appreciably improved.

Construction Purchases Active in the Middle West

CENTRAL-STATION construction work continues an important factor in the Middle West. Industrial purchasing is quite active and the volume of business is increasing. Among the interesting orders received from the utility companies was one for 10,000 5-amp. watt-hour meters and 600 direct-current watt-hour meters. There was quite a demand for circuit breakers, and excellent sales of pole-line hardware were recorded. Cable manufacturers have booked considerable business lately and one manufacturer reports that the volume of sales for this territory during June were 100 per cent ahead of the same period last year. In general the demand for electric-service equipment is up to that estimated several months ago from buyers' plans at that time.

Jobbers' sales have improved somewhat. Considerable quantities of roughing-in materials were sold, and a manufacturer of outlet boxes states that he has two months business on his books at this time. Appliance sales are steady and the demand for motors is quite satisfactory. Prices are firm, with an upward tendency. As copper prices have stiffened there occurs a persistent rumor of a further advance in code-wire prices. Several changes of a minor nature in the prices of wiring devices were announced. Owing to an unusual situation in the Chicago district, conduit prices were reduced to the jobber. This condition is not expected to continue for any great length of time.

Activities of the Trade

Westinghouse to Erect Office Building at East Pittsburgh

An eleven-story office building, 136 ft. high and 56 ft. wide, costing approximately $1,000,000, will be built at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company, to take care of continued expansion of business. Small buildings on the site of the new structure have been razed, and erection of the building will be completed within a year. That the company would shortly undertake the construction of this building was announced in the June 13 issue of ELECTRICAL WORLD. The new building will centralize the office forces of the various departments which are now scattered throughout the factory. It will add 175,000 sq.ft. to the present office floor area at the plant.

Altorfer Bros. Hold Convention of Jobbers and Distributors

Leading jobbers and distributors of washing machines from all over the country met at Peoria, Ill., on June 8 and 9 to view the first public showing of the latest product of the Altorfer Bros. Company. During these two days, a careful study was made of the manufacturing methods, and the company presented to the visitors a very complete merchandising sales and advertising program. The company announces that it is now in production on its "ABC Double A" electric washer, which is of the gyrator type, and that shipments are going forward daily.

Refrigerator Manufacturers Rumored to Be Forming Merger

It is rumored that negotiations are under way for a $20,000,000 merger of electrical refrigerator companies. The companies named in the deal are the Kelvinator Corporation, Detroit, manufacturer of domestic refrigerators; the Nizer Corporation, manufacturer of refrigerators for ice cream cabinets and other commercial uses, and another prominent manufacturer of domestic and commercial machines.

The ELECTRICAL WORLD on communicating with the companies named was informed by G. P. Cowan, president of the Nizer Corporation, that "There is nothing to these rumors and accordingly we have nothing to report." The Kelvinator Corporation reports that A. H. Goss, president, is in Europe and that nothing is known of the rumored merger mentioned at the office of the company.

The Simplex Electric Heating Company, Cambridge, Mass., has placed on the market an entirely new line of full-enameled electric ranges. The new ranges are made in three types (either left or right-hand). The company states that two new special apartment models in smaller size will shortly be announced.

The Square D Company, Detroit, manufacturer of electrical safety devices, announces that it has placed on the market a new motor-starting switch for use with time-limit protective cut-outs. The switch can be used with motors of 3 hp. and below on 110 volts, and with motors rated above 3 hp. up to and including 5 hp. on 220 volts.

The Industrial Advertising Company, 615 Wayne Street, Detroit, announces that effective July 1 Emanuel G. Frank and Roland G. Spedden will be associated with Sidney M. Fecheimer and that the company will hereafter be known as Fecheimer, Frank & Spedden, Inc. New and enlarged offices will be located at 415 Brainard Street, Detroit. Mr. Frank, vice-president of the new company, was formerly in charge of the copy department of the Campbell-Ewald Company, Detroit. Mr.

Spedden, secretary of the new company, was formerly in charge of the retail advertising department of the Campbell-Ewald Company. Mr. Fecheimer is president of the new company.

The Circle F Manufacturing Company, Trenton, N. J., manufacturer of electrical and porcelain specialties, announces that it has added the following to its list of representatives: Walter H. Dyer & Company, Arcade Building, St. Louis, which will cover the state of Missouri and the territory formerly covered by the Wood & Lane Company; the Warren C. Graham Company, 208 Godchaux Building, New Orleans, La., which will cover the states of Louisiana, Alabama and Mississippi, and B. B. Downs & Sons, 2126 Iglehart Avenue, St. Paul, Minn., which will cover the states of Minnesota, North Dakota and South Dakota.

The Wadsworth Electric Manufacturing Company, Covington, Ky., announces that it has placed on the market a new type of motor-starting safety switch.

New Equipment Available

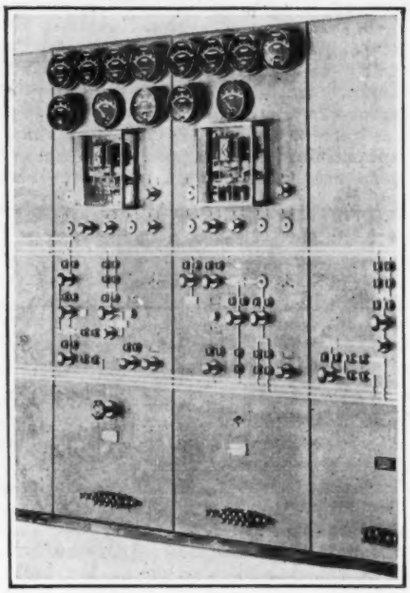
Worm-Gear Reduction Unit

A complete series of standard worm-gear reduction units, designated as Type AT, have been placed on the market by the Cleveland Worm & Gear Company, 3275 East Eightieth Street, Cleveland. The housing of the Type AT unit is of the square design, similar to the housing of the Type AH, developed two years ago to accommodate overhung loads. This housing is said to provide ample oil capacity and a large surface area.

High-grade tapered roller bearings are used for the gear-shaft mounting, and the worm is mounted in heavy ball bearings. The gearing furnished in these units is of the automotive type. All bearings and the gear contact are lubricated by splash from the large oil reservoir in the bottom of the housing. One filling of the reservoir provides effective lubrication for several months. In the design of this additional series the distances between the worm and gear centers and between the shafts and the bottoms of the housing conform to the standards established by the company. All types of Cleveland units are, therefore, interchangeable in an installation. A large number of sizes of these units are available with ratios ranging from four to one to one hundred to one and load capacities from ¼-hp. to several hundred horsepower.

Steel Switchboard

A new type of switchboard, constructed of "stretcher level sheet steel," has been designed by the Westinghouse Electric & Manufacturing Company, and may be used in power, railway, industrial and marine installations. This new type of switchboard is said to be light, substantial, sturdy and easily erected. For some time these steel switchboards have been used by the company on small installations in a more or less experimental way and have proved successful, so that they are now available and are being installed on larger projects. The outstanding features of this new type, according to the manufacturer, are its lightness, substantial nature, lower maintenance costs, appearance and inexpensiveness. The erection, which is said to be cheaper, is more simple since the framework is an integral part of the panels. The steel panels are given a baked enamel finish similar to that used in the automobile industry, making them impervious to moisture and to the corroding action of salt sea air.



FRONT VIEW OF PORTION OF STEEL SWITCHBOARD INSTALLATION AT STATEN ISLAND, N. Y.

The most important installations from the power and railway standpoint are those of the Staten Island project which is part of the complete electrification of the Baltimore & Ohio system from Baltimore to New York, and the installation in the automatic substations of the Steubenville, East Liverpool & Beaver Valley Traction Company.

Alternating-Current Distant Dial

A distant dial which operates on alternating current, thus eliminating the need for batteries to operate the mechanism in cases where alternating current only is available, has been developed by the Sangamo Electric Company, Springfield, Ill. The alternating-current distant dial, like the direct-current type, is intended for duplicating at a convenient location the readings of a watt-hour meter, for totalizing the revolutions or strokes of engines, generators or other machines, or for summarizing on a single dial the total registration of a group of watt-hour meters.

The motor structure of the alternating-current distant dial is bipolar, each pole carrying two solenoids. Energy for operating these solenoids is obtained from a low-voltage transformer. The transformer used has a three-wire secondary permitting the reversing mechanism on the recording train of the meter to be of the three-lead type, such as is also used with direct-current distant dials. Where desired the distant-dial mechanism may be equipped with contacts for operating printometers or other graphic devices for indicating demand.

Paper Speed Regulator

A new speed regulator for single-motor paper-machine drive, designed and marketed by the General Electric Company, is now in successful operation in a number of Eastern mills. This regulator was designed with the object of eliminating variations in the speed of the back-line shaft which might occur as a result of any of a number of conditions such as variations in speed of the prime mover, belt slippage, etc.

The regulator consists primarily of a small pilot generator driven directly from the back-line shaft of the paper machine in such a way that its speed is always directly proportional to the speed of the back-line shaft. This pilot generator is so designed that any variation in its speed will cause a wide variation in the voltage across its terminals, and this variation of terminal voltage operates to change the field strength of the main driving motor, thus insuring constant speed of the back-line shaft driven by that motor.

Traffic Signal Timer.—A traffic signal timer built especially for operating traffic signals has been placed on the market by the Griswold Safety Signal Company, 20 East Hennepin Avenue, Minneapolis. The timer is easily adjusted to give any desired time cycle with any time ratio between signals. The warning light is controlled independently. The device may be used to control one signal or a number of them. The unit is mounted in a weatherproof steel cabinet and is readily adaptable to manual control.

Ironing Machine.—An electrically-driven ironing machine which is able to deliver 5 hp. at the moment the pressure is applied through the use of a ¼-hp. motor is that manufactured by the Prosperity Company. This machine, called the "Ezypress," is enabled to do this by means of flywheel momentum. A Westinghouse ¼-hp. motor is used, and the operations are controlled by a clutch mechanism. The head of the machine is locked under pressure by one-half revolution of the cam, which is actuated by the full force of the energy stored in the flywheel for each operation. This machine is so designed that no power can be applied until the head of the machine has been lowered to such an extent that it is impossible for the operator to insert his fingers between the bucks. This machine is steam-heated and applies a pressure of about 7 lb. per square inch as compared with 4 lb. with a hand iron and 2 lb. with a foot-operated machine.

New Trade Literature

SPEED REDUCERS.—Bulletin No. 38 issued by the Falk Corporation, Milwaukee, covers the Falk speed reducers. It gives a sketch describing the method of manufacturing the speed reducer and calls attention to the advantages of its use in many industries. It also contains dimension tables of the various types of its speed reducers and illustrations showing typical installations.

AIR FILTERS.—The Midwest Air Filters, Inc., 100 East Forty-fifth Street, New York City, has issued a booklet (second edition), entitled "Method of Cleaning Atmospheric Air and the Chief Characteristics of Air Cleaners with Comments on Humidifiers," in which it describes the methods of cleaning atmospheric air with the Midwest air filters.

PRESSURE RECORDERS. — Bulletin No. 625, issued by the Easterline-Angus Company, Indianapolis, entitled "Graphic Pressure Recorders and Their Uses," describes and illustrates its graphic pressure recorders with the use of steam, water, air and other gases under pressure.

IMPULSE RELAY. — The States Company, Hartford, Conn., is distributing section 14 of catalog No. 1, describing the States selective impulse relay for use in testing meters singly or in groups. It contains illustrations showing both exterior and interior views of the relay and a wiring diagram for meter testing, with instructions for using the meter.

WATER SOFTENER.—Bulletin No. 509 issued by the Graver Corporation, East Chicago, Ind., describes and illustrates its "Zeolite" water-softening and purification equipment.

GALVANIZING.—"Diamond-Watrous Hot Galvanizing Process" is the title of bulletin No. 152, issued by the Diamond Expansion Bolt Company, 90 West Street, New York City, in which it describes and illustrates the "Diamond-Watrous" hot galvanizing process for applying metal coatings to iron and steel products to preserve them against destruction by rust and corrosion.

OUTDOOR SUBSTATION EQUIPMENT. —Bulletin No. 12 issued by the Delta-Star Electric Company, 2433 Fulton Street, Chicago, has been incorporated in the June 15 issue of the "Delta Star," which is a special outdoor substation issue. Three pages are devoted to its standardized "unit type" outdoor substations, which are primarily intended for installations by utilities serving or consumers buying from distribution lines of 37,000 volts or less. It contains a number of illustrations showing various installations of the "unit type" outdoor substations.

TRANSFORMERS. — The Pittsburgh Transformer Company, Pittsburgh, is distributing bulletin No. 2,044, in which it recounts some of the additional advantages of the Pittsburgh polyphase transformers.

ELECTRIC DUMB WAITER.—Bulletin F-18-B issued by the Warner Elevator Manufacturing Company, Cincinnati, describes and illustrates the Warner "Type F-18" electric dumb waiter.

GEARS.—The Niles-Bemont-Pond Company, 111 Broadway, New York City, is distributing circular No. 265-1, which describes and illustrates the various types of its "Maag" gears.

SAFETY SIGNAL.—"Your Traffic Problems and How to Solve Them" is the title of a booklet issued by the Griswold Safety Signal Company, 20 East Hennepin Avenue, Minneapolis, in which it describes and illustrates its "American Bobby" traffic signals. Attention is also called to the "Griswold" traffic signal, flexible time control and warning signal.

TACHOMETER.—James G. Biddle, 1211 Arch Street, Philadelphia, is distributing bulletin No. 1,080, covering its Jagabi type "B" stationary tachometer for the continuous indication of speed.

REFRIGERATION MOTOR.—The Century Electric Company, St. Louis, is distributing a folder calling attention to the use of the Century repulsion-start induction, single-phase refrigeration motor of the brush-lifting type for household refrigerating machines.

CONTROL DEVICES.—Bulletin No. 801, issued by the Reynolds Electric Company, 2650 West Congress Street, Chicago, describes and illustrates its "Reco" special control device, including flashers, timers and controllers.

INDUSTRIAL WORM GEAR UNIT.—The Cleveland Worm & Gear Company, Payne Avenue and East Fortieth Street, Cleveland, Ohio, is distributing bulletin No. 104 describing the type "AT" Cleveland worm gear reduction unit.

STEAM TRAP.—The W. B. Connor Company, Inc., 223 West Thirty-third Street, New York City, is distributing catalog A-1926, which shows in detail the design, construction and method of operation of the "A C E" Corliss valve steam trap.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase or agency is desired in London, England (No. 15,770) for insulating materials, radio parts, battery separators and wire, insulated and bare.

Purchase is desired in Amsterdam, The Netherlands (No. 15,773) of insulating materials; (No. 15,773) for transformer sheets for radio service.

Purchase and agency is desired in Berlin, Germany (No. 15,772) for lamps and lighting fixtures of all kinds for cinema studio.

Purchase and agency is desired in Nairobi, Africa (No. 15,778) for long-range radio receiving sets.

Purchase and agency is desired in Bradford, England (No. 15,769) for radio sets, tubes and parts, best quality.

An agency is desired in Amritsar, India (No. 15,744) for oil engines.

An agency is desired in Bombay, India (No. 15,745) for steam engines.

Purchase and agency is desired in Malmo, Sweden (No. 15,790) for personal automatic scales with electric power.

Construction News

Projects, Plans, Bids and Contracts, Conteplated or Under Way.

New England States

NORTH ABINGTON, MASS.—Arrangements are being made by the Electric Light & Power Company for an issue of $136,000 in capital stock, part of the proceeds to be used for extensions and improvements.

REVERE BEACH, MASS.—The Municipal Distract Commission, Boston, has awarded a contract to the Suburban Gas & Electric Company for the installation of its second park unit lighting system, extending from Revere Beach to Medford, via Chelsea and Everett, to cost about $50,000.

WORCESTER, MASS.—The City Council has appropriated $50,000 for new fire-alarm equipment.

WESTPORT, CONN. — The Westport Electric Company has been organized by officials of the Connecticut Light & Power Company, Waterbury to take over the electric system of the Westport Water Company. Extensions and improvements are contemplated.

Middle Atlantic States

BINGHAMTON, N. Y.—Work has begun by the Binghamton Light, Heat & Power Company on the construction of a substation and a double-circuit transmission line, to cost about $125,000, as the first step in providing a "power loop" for its territory. The line will be extended with additional automatic substations until it encircles the municipality.

IROQUOIS, N. Y.—Bids will be received by F. R. Cutter, superintendent of purchase, Capitol, Albany, until July 14, for heating work, new boiler and alterations to power plant at the Thomas Indian School at Iroquois.

LE ROY, N. Y.—The Council is considering installing ornamental lamps on East Main, West Main, Wolcott, Lake and Clay Streets.

LUZERNE, N. Y. — The Adirondack Power & Light Corporation, Schenectady, has applied for permission to construct and operate a steam-operated electric power station here.

ST. GEORGE, N. Y.—The Staten Island Edison Corporation has commissioned the J. G. White Engineering Corporation, 43 Exchange Place, New York, to design and construct a conduit line along the north shore, about 9,000 ft. long, located on the Baltimore and Ohio Railroad right-of-way from Livingston power house west of Livingston Avenue, containing two 33,000-volt cables. From this point to approximately the location of the Arlington station of the Baltimore Railroad, the line will be carried on poles. At a location to be decided upon later a combined substation will be built, equipped for both lighting and railroad service.

TONAWANDA, N. Y.—The J. E. Wallace Company plans to build a power plant in connection with the rebuilding of its lumber mill on Tonawanda Island, recently destroyed by fire.

LINDEN, N. J.—An ordinance appropriating $9,000 for extension of the fire-alarm system, installation of a new switchboard, etc., and another ordinance providing $3,000 for the installation of additional police call boxes are under consideration by the Council.

WHARTON, N. J. — Steps have been taken by the Fire Department to install an improved fire-alarm system.

GROVE CITY, PA.—The City Council is planning to install an ornamental lighting system on Broad Street, using iron standards with 600-watt lamps.

PHILADELPHIA, PA.—Improvements in the Moore School of Electrical Engineering, including the installation of additional equipment, to cost about $200,000, is under consideration by the trustees of the University of Pennsylvania.

SALISBURY, MD.—The City Council is considering the installation of an improved lighting system on Main Street.

HUNTINGTON, W. VA. — The Boldt Glass Company, Cincinnati, Ohio, plans to rebuild its power plant and other buildings recently destroyed by fire with loss of about $350,000.

SPENCER, W. VA.—The City Council is planning to install an ornamental lighting system in the business district, to cost about $10,000.

MINERAL, VA. — The Louisa County Light & Power Company, recently organized plans to build a power plant. The company has franchises in Mineral and Louisa and contracts for street lighting.

WASHINGTON, D. C. — Bids will be received by the Purchasing Clerk, Bureau of Engraving and Printing, until July 14, for three 200-kva. transformers, 115 and 230 volts, 25 cycle, and also, for one switchboard, 25 cycle 230-6 panel single circuit.

North Central States

BROOK PARK, OHIO.—The City Council is considering a bond issue of $25,000 to install an electric street lighting system throughout the city. Post office address Cleveland.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until July 17 for furnishing material and erecting complete the Windsor Avenue transformer house.

CLEVELAND, OHIO. — Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until July 17 for furnishing and installing steam and return line, complete, for Baldwin-Fairmount project for the Department of Public Utilities, Division of Water and Heat.

CLEVELAND, OHIO.—Plans are being prepared for the construction of a marine hospital, including main hospital, nurses' home, attendants' home and power house, at East 124th Street and Fairmount Road, to cost about $1,000,000. Major J. P. Bahrenburg, East Ninth Street and Lakeside Avenue, is in charge.

MARBLEHEAD, OHIO. — The property of the Marblehead Power Company has been acquired by the Ohio Public Service Company. The local plant will be closed down and local service will be supplied from a 132,000-volt transmission line, now under construction, between Lorain and Sandusky.

MONROEVILLE, OHIO.—Plans for the proposed factory building to be erected by Yinglying Brothers, to cost about $50,000, include a power house.

LANSING, ILL.—Bids will be received by the President and Trustees of the village of Lansing until July 21 for improvements to waterworks, including one 16-in. well, one motor-driven centrifugal pump of deep well turbine type, pump house and steel tower. Ashdown, Williams & Company, Chicago Heights, are engineers.

GILMAN, WIS.—At an election held recently the proposal of the Northern States Power Company, Eau Claire, to extend its transmission line from Thorp to Gilman, a distance of 20 miles, to furnish service here was approved by the voters. Bonds to the amount of $15,000 to finance the project were authorized.

GREEN BAY, WIS.—The Wisconsin Public Service Corporation which is erecting a number of extensions to its transmission system, plans to build a rural line from Maribel Caves to Cooperstown, and will also erect a branch line from the Green Bay-Oshkosh line to supply energy at Little Rapids, where a substation will be built.

LIMERIDGE, WIS.—The Wisconsin Power & Light Company, Madison, has acquired the municipal electric plant and distribution system.

STOUGHTON, WIS.—Plans are under consideration by the City Council to replace two water wheels at the power house of the waterworks with a vertical turbine direct connected to generator, to cost about $10,000.

BUHL, MINN.—Bids will be received by A. A. Williams, light and power commissioner, until July 14, for extensions and improvements in the municipal electric plant, including the installation of additional equipment, coal and ash-handling machinery, etc. Charles Foster, Sellwood Building, Duluth, is engineer.

ST. PAUL, MINN.—The Ford Motor Company, Detroit, plans to install electric power equipment in connection with proposed additions to its local plant, for glass manufacture, etc., to cost about $3,500,000.

CHEROKEE, IOWA.—The United Gas Improvement Company, Philadelphia, which recently acquired the property of the Cherokee Electric Company, plans to erect a 66,000-volt transmission line to Humboldt, about 125 miles, to cost about $750,000.

LINN GROVE, IOWA.—The Western Iowa Power & Light Company, Peterson, is planning to rebuild its local power plant recently damaged by fire.

ROCKWELL, IOWA. — Permission has been granted the Central Iowa Power & Light Company, Waterloo, to erect transmission lines in Floyd and Cerro Cordo Counties, radiating from Rockwell; in Dickinson, Clay and Palo Alto Counties, to radiate from Milford and Emmetsburg, and Bremer County, and also a line to the town of Dougherty.

KANSAS CITY, MO.—The municipal projects committee of the Public Improvements Association has voted to recommend that a bond issue of $200,000 for traffic lamp signals be included in the fall bond issue for public improvements.

KANSAS CITY, MO.—Plans are under consideration by the Fire and Water Board for extensions to the automatic fire-alarm system, etc., to cost about $500,000. W. B. Buckholz is chairman of the board.

ST. LOUIS, MO.—The Board of Aldermen has approved three ordinances appropriating $2,000,000 for street-lighting, of which $400,000 will be used for the business district, $1,350,000 to be used for two districts in north and south St. Louis, and $250,000 for lighting equipment on reconstructed streets.

RUGBY, N. D.—The City Council is considering the installation of an ornamental lighting system in the downtown district.

HOT SPRINGS, S. D.—Bids will be received by the United States Veterans' Bureau, Room 791, Arlington Building, Washington, D. C., for construction of buildings and utilities to be built on property occupied by the National Home for Disabled Volunteer Soldiers, Battle Mountain Sanitarium, Hot Springs. Separate bids will be received for building construction, plumbing, heating, electrical work, elevators, ice-making and refrigerating plant, and concrete stack, etc. Frank T. Hines is director.

Southern States

CERRO GORDO, N. C.—A franchise has been granted the Tidewater Power Company, Wilmington, to supply electricity here. The company will erect a substation and distributing system. Service for the present will be supplied from Whiteville.

CHARLOTTE, N. C.—The Southern Power Company plans extensions in the street-lighting system in the Ridgewood, Grayson Park and Progress districts.

MONROE, N. C.—At an election to be held Aug. 4 the proposal to issue $200,000 in bonds for extensions and improvements to the municipal electric plant and waterworks system will be submitted to the voters.

BENNETTVILLE, S. C.—A new boiler or an oil engine of about 300 hp. will be installed in the municipal electric plant this year. E. C. Morrison is manager.

COLUMBIA, S. C. — The Broad River Power Company has plans under way for extensions to its steam-operated electric plant, including the installation of a 27,000-hp. generator and auxiliary equipment, to cost about $450,000.

ROCK HILL, S. C.—W. P. Goodman, city manager, plans to install an ornamental lighting system on Oakland Avenue, from Stewart Avenue to the city limits.

FORT PIERCE, FLA.—Bids will be received by the Mayor and Commissioners until July 22 for furnishing a steam turbo-generator with condenser, condenser pumps, generator panel and auxiliary equipment. Plans and specifications are on file at the office of the American Industries Engineering Company, 140 Cedar Street, New York City.

TAMPA, FLA.—Plans for the proposed local truck manufacturing plant to be built by the Mutual Truck Corporation, Sullivan, Ind., include a power plant. The cost of the project is estimated at about $250,000.

WEST PALM BEACH, FLA.—The City Commission has passed a resolution for establishing street lighting district No. 1, which provides for the installation of an ornamental lighting system, to cost about $220,000, in connection with the proposed improvement program, to cost about $2,700,000.

JACKSON, TENN.—At an election to be held soon the proposal to issue $60,000 in bonds for the installation of a new street-lighting system will be submitted to the voters.

FLOMATON, ALA.—The Gulf Electric Company, Birmingham, has petitioned the Public Service Commission for permission to erect an electric plant and distribution system in Flomaton. Later the company proposes to connect the local system with its proposed hydroelectric line in this section.

HATTIESBURG, MISS.—The Mississippi Power Company, Gulfport, contemplates extensions in its local electric plant, including the installation of a new generating unit.

GRADY, ARK.—The Arkansas Light & Power Company, Pine Bluff, plans extensions in its transmission lines in this section.

FORGAN, OKLA.—The Municipal Electric Department contemplates the erection of about 10,000 ft. of transmission line during 1925. C. E. Crites is superintendent.

HOLLIS, OKLA.—Improvements contemplated by the Hollis Light & Ice Company this year include the installation of another circuit for motors. All 110-volt distribution lines are now being changed to 220/110, three-wire. The company is also planning to install another 200-hp. oil engine. Anna V. Miller is owner and manager.

McALESTER, OKLA.—The Southwest Power Company plans extensions and improvements in its local electric plant, to cost about $15,000.

BASTROP, TEX.—The Texas Power & Light Company, Dallas, is considering the construction of a steam-operated power plant in Bastrop, to cost about $100,000.

NEW BRAUNFELS, TEX.—The Comal Power Company, San Antonio, subsidiary of the San Antonio Public Service Company, plans to purchase additional electric machinery, to cost about $1,000,000, for its local power plant, now under construction, near here.

SAN MARCOS, TEX.—The Texas Utilities Company, Plainview, Tex., contemplates improvements in its local power plant, erection of substation transmission line and ice plant.

Pacific and Mountain States

CONCRETE, WASH.—The Puget Sound Power & Light Company, Seattle, contemplates extensions and improvements to its local substation.

OLYMPIA, WASH. — Application has been made to the Commissioners of Thurston County by the West Coast Power Company, Gasco Building, Portland, Ore., for a franchise to erect transmission lines over various roads in the county as follows: From Grays Harbor county line to Rochester, from Rochester to Helsing Junction, and thence to the Lewis County line.

COLTON, CAL.—The City Council has adopted an ordinance providing for the installation of ornamental lamps on I Street, Colton Avenue and other streets, using concrete standards.

LOS ANGELES, CAL.—Bids will be received by the Public Service Commission, 207 South Broadway, until July 21, for high voltage transformers (Specification P-357). James P. Vroman is secretary.

LOS ANGELES, CAL.—Plans are being prepared by the Los Angeles Gas & Electric Company for the erection of a substation at 1033 Santee Street.

LOS ANGELES, CAL.—The State Railroad Commission has granted the Southern California Edison Company permission to erect a high-tension transmission line through Fresno, Kern, Tulare and Los Angeles counties.

LOS ANGELES, CAL.—The Bureau of Power and Light plans to install a submarine power cable at the entrance of the West Basin, Los Angeles Harbor.

LOS ANGELES, CAL.—Plans are being prepared by the Department of Public Service, Bureau of Power and Light, for the erection of a substation at 4855 San Vicente Boulevard, to cost about $36,000.

LOS ANGELES, CAL.—The City Council has adopted ordinances providing for the installation of ornamental lamps on Glendale Boulevard, First and Figueroa Streets and Maplewood Avenue, using pressed steel standards.

MARYSVILLE, CAL. — Arrangements are being made by the Pacific Gas & Electric Company, San Francisco, for the reconstruction of the Durham Junction-Marysville 60,000-volt transmission line, in the De Sabla division, at a cost of about $20,000.

MERCED, CAL.—Bids will be received by the Merced Irrigation District, Barcroft Building, until July 28, for operating equipment, etc., for the spillway gates at the Exchequer dam and power plant.

SACRAMENTO, CAL.—The Sacramento Municipal Utility District plans to build a hydroelectric plant in connection with a proposed water development at Silver Creek. A proposal to issue $500,000 in bonds for initial work and for approval of the project will soon be submitted to voters.

SAN DIEGO, CAL.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 22 for refrigerators, piping, electrical work, etc., at the local Naval operating base hospital (Specification 5,122).

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company plans to build an addition to its substation at Leidesdorff and Sacramento Streets, to cost about $85,000.

SAN FRANCISCO, CAL.—An agreement has been made whereby the Great Western Power Company will purchase the output of the Bald Rock power plant of the Feather River Power Company. The plant will be the first of six in a development which will produce 400,000 hp. to cost between $45,000,000 and $50,000,000. It will contain two units operating under a head of 2,580 ft. A dam across the Feather River will create a storage reservoir of 110,000 acre-feet capacity. The Great Western Power Company will take energy at the power house, which will be transmitted at 220 kv. Work will begin as soon as a permit is granted by the Federal Power Commission.

Canada

COCHRANE, ONT.—The officials of the Abitibi Power & Light Company, Montreal, are reported to be negotiating with the Town Council to furnish electricity to the town from its proposed new plant.

QUEBEC, QUE. — The Quebec government, it is announced, has accept the plans of J. B. Duke and associates for the development of an additional 600,000 hp. in the Lake St. John district. The project includes a hydro-elecytric plant at the mouth of the Saguenay River at Chute à Caron, near the Grande Décharge dam, and the construction of a large aluminum plant. The initial installation provides for an expenditure of $40,000,000, with an ultimate expenditure of $75,000,000 to $90,000,000. The project also includes the construction of a model town.

Electrical Patents

Announced by U. S. Patent Office

(Issued June 2, 1925)

1,540,692. THERMAL RESPONSIVE MANUALLY OPERABLE SWITCH; C. I. Hall, Fort Wayne, Ind. App. filed July 11, 1921.

1,540,693. THERMAL RESPONSIVE DEVICE; C. I. Hall, Fort Wayne, Ind. App. filed March 22, 1923. To protect from conditions caused by unbalancing of the phases.

1,540,698. VOLTAGE REGULATION FOR GENERATORS; B. M. Leece, Cleveland, Ohio. App. filed Dec. 10, 1923.

1,540,705. ARC-WELDING APPARATUS; P. O. Noble, Schenectady, N. Y. App. filed Sept. 16, 1924. For welding a plurality of seam welds in succession.

1,540,710. PRINTING TELEGRAPHY; H. Pfannenstiehl, Orange, N. J. App. filed July 29, 1918.

1,540,712. SIGNAL SENDING APPARATUS IN WAVE TELEGRAPHY; L. Pungs, Berlin-Charlottenburg, Germany. App. filed Aug. 23, 1921.

(Issued June 9, 1925)

1,540,750. ELECTROMAGNETIC DEVICE; W. O. Beck, Ridgefield, N. J. App. filed June 20, 1921. Relay having high sensitivity and operable at high speeds.

1,540,752. GARAGE LIGHT; A. T. Sampson, Lynn, Mass. App. filed April 7, 1923.

1,540,770. FILAR CONTROL; M. B. Field, Glasgow, Scotland. App. filed Oct. 12, 1921. In a measuring instrument.

1,540,773. STAND LAMP; J. Goldman, Chicago, Ill. App. filed Nov. 8, 1924.

1,540,775. WATCHMAN'S SERVICE; F. L. Grauel, Rochester, N. Y. App. filed Aug. 20, 1919.

1,540,786. TELEPHONE SYSTEM; C. E. Lomax, Chicago, Ill. App. filed Jan. 11, 1923. Combined with a watchman's service system.

1,540,795. CABINET FOR ELECTRIC SWITCHES; P. E. Monson, Berkeley, Cal. App. filed July 15, 1918.

1,540,797. SIGNALING SYSTEM; P. B. Murphy, Nyack, N. Y. App. filed May 8, 1920.

1,540,799. SYSTEM FOR MEASURING THE CAPACITY OF ELECTRICAL CIRCUITS; D. Nunn, West Keningson, London, England. App. filed Feb. 6, 1923.

1,540,835. TELEGRAPH REPEATER; B. P. Hamilton, River Edge, N. J. App. filed May 7, 1924.

1,540,847. ACCUMULATOR; L. A. Lammerts, Arnheim, Netherlands. App. filed Dec. 26, 1923.

1,540,849. SIGNAL STORING ARRANGEMENT; O. H. Loynes, Brooklyn, N. Y. App. filed May 15, 1924.

1,540,881. RECEIVING SYSTEM FOR RADIANT ENERGY; J. H. Hammond, Jr., Gloucester, Mass. App. filed July 9, 1918.

1,540,893. OUTLET BOX; J. J. Merrill, Ipswich, Mass. App. filed Sept. 14, 1921.

1,540,936. AUTOMATIC GAS AND ELECTRIC COUPLING FOR RAILWAY CARS; T. P. Garankin, New York, N. Y. App. filed March 15, 1923.

1,540,964. ELECTRIC IMMERSION HEATER; J. N. Trahan, Quebec, Canada. App. filed May 16, 1924.

1,540,998. CONVERSION OF ATMOSPHERIC ELECTRICAL ENERGY; H. Plauson, Hamburg, Germany. App. filed Jan. 13, 1921.

1,541,014. HAND ELECTRIC LAMP; E. Wagner, Wauwatosa, Wis. App. filed Dec. 5, 1923. Dry-cell type.

1,541,015. ELECTRIC SWITCH; W. W. Weeks, Brooklyn, N. Y. App. filed May 25, 1923. Elevator door control switch.

1,541,024. ATTACHMENT PLUG; R. B. Benjamin, Chicago, Ill. App. filed Oct. 30, 1919.

1,541,076. ELECTRIC RAILWAY; J. B. Strauss, Chicago, Ill. App. filed July, 31, 1915. Systems in which a series of exposed contacts are located along the trackway to be successively engaged by contact devices carried by the car.

1,541,121. INSULATING MEDIUM FOR TRANSMISSION OF INTELLIGIBLE SOUNDS; F. C. Dobel, Winchester, Mass. App. filed Aug. 2, 1920.

1,541,138. ELECTRIC CLOCK; A. B. Harje, Copenhagen, Denmark. App. filed March 15, 1922. With electrically driven pendulum.

1,541,149. AUTOMATIC TELEPHONE SYSTEM; E. Jacobsen, Evanston, Ill. App. filed March 19, 1917. Private automatic exchange.

1,541,164. AUTOMATIC TELEPHONE SWITCH; V. F. Miller, New York, N. Y. App. filed July 5, 1922.

1,541,193. ELECTRICAL SWITCHING APPARATUS; P. C. Smith, East Orange, N. J. App. filed Dec. 5, 1922. Employed in telephone-exchange systems.

1,541,194. ELECTRICAL SWITCHING DEVICE; P. C. Smith, East Orange, N. J. App. filed Dec. 8, 1922. Applied to telephone-exchange system.

1,541,196. TELEPHONE SYSTEM; A. B. Sperry, New York, N. Y. App. filed Feb. 15, 1923. Machine switching.

1,541,221. COMBINED SUPPORT AND CONTROL DEVICE FOR ELECTRIC IRONS; J. F. Johnson, Baltimore, Md. App. filed July 7, 1924.

1,541,229. AUTOMATIC TELEGRAPH SYSTEM; G. A. Locke, Glen Cove, N. Y. App. filed Nov. 23, 1922.

1,541,252. ELECTRIC CUT-OUT; R. Dederer, Sindelfingen, Wurttemberg, Germany. App. filed Aug. 17, 1921. Indicating non-renewable fuse.

1,541,259. LIGHTING FIXTURE; E. F. Guth, St. Louis, Mo. App. filed Feb. 23, 1923. Semi-direct.

1,541,291. TELEPHONE-EXCHANGE SYSTEM; D. L. Temple, New York, N. Y. App. filed Nov. 28, 1922. Machine switching.

1,541,305. MULTIPLE-FUSE PLUG; G. T. Woodin, Newport, N. Y. App. filed July 30, 1921.

1,541,308. TELEPHONE SYSTEM; W. P. Albert, East Orange, N. J. App. filed Aug. 31, 1923. With metering mechanism.

1,541,311. VACUUM-TUBE CIRCUITS; S. E. Anderson, Brooklyn, N. Y. App. filed Feb. 7, 1923.

1,541,316. AUTOMATIC TELEGRAPHC SYSTEM; E. P. Bancroft, Brooklyn, and M. B. Kerr, New York, N. Y. App. filed July 1, 1920.

1,541,324. ELECTRIC SOLDERING IRON; C. M. Chapman, Terryville, Conn. App. filed Nov. 19, 1924.

1,541,341. CONTACT BANK FOR CO-ORDINATE SWITCHES; O. F. Forsberg, Yonkers, N. Y. App. filed Feb. 23, 1923.

1,541,343. SWITCHING DEVICE; H. W. Goff, New York, N. Y. App. filed Oct. 12, 1921. Contact-making apparatus used in telephone-exchange system.

1,541,344. SWITCHING MECHANISM; H. W. Goff, New York, N. Y. App. filed June 27, 1922. For automatic telephone-exchange system.

1,541,347. TELEPHONE-EXCHANGE SYSTEM; C. L. Goodrum, New York, N. Y. App. filed July 1, 1920. For private-branch automatic exchanges with central offices.

1,541,356. MESSAGE-REGISTER SYSTEM; F. S. Irvine, Huntington, N. Y. App. filed Nov. 24, 1922. For telephone exchanges.

1,541,359. TELEPHONE SYSTEM; A. F. Kane' New York, N. Y. App. filed April 10, 1923. Co-ordinate switching apparatus.

1,541,363. ELECTRIC SWITCH; A. R. Locke, Chicago, Ill. App. filed May 21, 1921. Toggle type for panel mounting.

1,541,367. TELEPHONE-EXCHANGE SYSTEM; J. L. McQuarrie, New York, N. Y. App. filed Feb. 28, 1923. Automatic.

1,541,368. TELEPHONE-EXCHANGE SYSTEM; G. R. Martin, East Orange, N. J. App. filed Dec. 19, 1923.

1,541,386. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; L. Polinkowsky, New York, N. Y. App. filed Feb. 6, 1919.

1,541,387. TELEPHONE SYSTEM; L. Polinkowsky, Antwerp, Belgium. App. filed Jan. 5, 1923. Automatic; for small private-branch exchanges.

1,541,388. AUTOMATIC TELEPHONE-EXCHANGE SYSTEM; L. Polinkowsky, Antwerp, Belgium. App. filed June 13, 1923.

1,541,400. AUTOMATIC TELEPHONE SYSTEM; J. Savin, Liverpool, England. App. filed Jan. 12, 1921.

1,541,401. AUTOMATIC TELEPHONE SYSTEM; J. Savin and R. Mercer, Liverpool, England. App. filed Jan. 12, 1921.

1,541,408. TELEPHONE EXCHANGE SYSTEM; F. A. Stearn, Paterson, N. J. App. filed April 11, 1921. Combined machine switching and manual operation.

1,541,418. ELECTRICALLY HEATED PERCOLATOR; J. Koenig and R. Koenig, Manitowoc, Wis. App. filed Dec. 3, 1923.

1,541,442. METHOD OF WINDING ARMATURES; R. H. Sullivan, Rochester, N. Y. App. filed March 6, 1924. Slotted armatures lap-wound directly in the slots.

1,541,454. ELECTROPLATING MACHINE; W. W. Wells, Toronto, Ontario, Canada. App. filed Jan. 21, 1922.

1,541,470. ELECTRICAL SWITCHING DEVICE; G. A. Betulander, Sodertorne Villastad, Sweden. App. filed Aug. 17, 1921. For telephone system.

1,541,472. COOKING APPLIANCE; W. F. Born, Lakewood, Ohio. App. filed Nov. 30, 1923.

1,541,484. HIGH-VOLTAGE ELECTRON TUBE; W. Daumann, Hamburg, Germany. App. filed Feb. 7, 1922.

1,541,485. ELECTRIC SWITCH BOX; E. Dennis, Detroit, Mich. App. filed March 8, 1922.

1,541,493. WIRE HANGER; A. J. Gurney, Canton, Ohio. App. filed June 14, 1924. For trolley wires.

1,541,507. METHOD OF WELDING CAST IRON; J. Jeffrey, Chico, Cal. App. filed Dec. 26, 1922.

1,541,513. ELECTRIC RESISTANCE WELDING; W. A. Knoop, East Newport, N. Y. App. filed March 4, 1920.

1,541,537. ADAPTER FOR CONNECTING DEVICES; G. C. Thomas, Jr., Elizabeth, N. J. App. filed May 4, 1921.

1,541,566. SYSTEM FOR PRODUCING OSCILLATIONS; A. W. Hull, Schenectady, N. Y. App. filed May 18, 1921.

1,541,576. CIRCULATING AND RADIATING HEATER; A. Johnson, Oakland, Cal. App. filed July 1, 1924.

1,541,582. ARC-WELDING MACHINE; W. L. Merrill, Schenectady, N. Y. App. filed April 28, 1924. Automatic.

1,541,596. FILAMENT FOR INCANDESCENT LAMPS OR OTHER VACUUM APPARATUS; F. Skaupy and F. Koref, Berlin, Germany. App. filed Nov. 3, 1924.

1,541,600. METHOD OF AND MEANS FOR OPERATING ELECTRIC FURNACES; C. Steenstrup, Schenectady, N. Y. App. filed May 11, 1923.

1,541,608. WIRELESS TELEGRAPHY; H. Abraham, Paris, France. App. filed Sept. 2, 1921.

1,541,609. CONTACT BRUSH FOR ELECTRIC MOTORS AND GENERATORS; C. W. Adams, Saginaw, Mich. App. filed June 14, 1924.

1,541,618. RELAY; H. W. Brown, Schenectady, N. Y. App. filed July 5, 1921. Highly sensitive; to operate in response to various circuit conditions such as predetermined current, undervoltage, reverse polarity, reverse power or combinations of these conditions.

1,541,626. TAPING MACHINE; P. E. Chapman, St. Louis, Mo. App. filed April 13, 1922.

1,541,627. X-RAY APPARATUS; W. D. Coolidge, Schenectady, N. Y. App. filed July 9, 1920.

1,541,632. NORMALLY CLOSED SWITCH; J. Eaton, Schenectady, N. Y. App. filed April 12, 1920. Biased to the closed position by the action of gravity.

1,541,646. ELECTRIC WATER HEATER; J. J. Kuhner, Highland, Ill. App. filed Oct. 2, 1920.

1,541,652. ELECTRICAL FUSE; A. J. Matter, Chicago, Ill. App. filed Jan. 14, 1921. Renewable fuse of the screw-plug type.

1,541,656. DYNAMO-ELECTRIC MACHINE; C. A. Parsons and J. Rosen, Newcastle-on-Tyne, England. App. filed Nov. 15, 1923. High-voltage alternating-current motors and generators.

1,541,660. ELECTRIC HEATER; C. P. Randolph, Oak Park, Ill. App. filed Nov. 30, 1923. Bowl-reflector type.

1,541,668. AMPLIFIER FOR SUBSCRIBERS' STATIONS; S. Srauss, Vienna, Austria. App. filed June 1, 1922.

1,541,699. ALKALINE ACCUMULATOR; F. A. Freeth and L. A. Munro, Hartford, England. App. filed Oct. 2, 1922.

1,541,720. PROTECTIVE ARRANGEMENT FOR ALTERNATING ELECTRIC CURRENT SYSTEMS; B. H. Lesson, Tynemouth, and R. W. Biles, Balcombe, England. App. filed Oct. 22, 1923.

(Issued June 16, 1925)

16,099 (reissue). APPARATUS FOR ADDING TO THE OUTPUT OF A MAIN POWER STATION THE OUTPUT OF ONE OR MORE DISTANT SOURCES; S. D. Sprong, Brooklyn, N. Y. App. filed April 12, 1918. As that of various hydro-electric plants at different points on the river.

1,541,779. ELECTROMECHANICAL TELEPHONE SYSTEM; F. Aldondorff, Berlin-Wilmersdorf, Germany. App. filed Nov. 16, 1922.

1,541,780. WAVE SIGNALING SYSTEM; E. H. Armstrong, Yonkers, N. Y. App. filed June 8, 1922.

1,541,813. SAFETY CIRCUIT CUT-OUT; M. Hochstadter, Gravenhage, Netherlands. App. filed Aug. 24, 1921. For the automatic disconnection of faulty sections of supply circuits.

1,541,814. ELECTROMAGNETIC CONTACTOR; C. H. Hodgkins and W. C. Goodwin, Pittsburgh, Pa. App. filed Feb. 20, 1920.

1,541,836. SOUND-LOCATING DEVICE; A. McNab, Bridgeport, Conn. App. filed Jan. 21, 1920.

1,541,845. ELECTRICAL WAVE TRANSMISSION; M. I. Pupin, Norfolk, Conn. App. filed Dec. 11, 1915.

1,541,857. CONTROL APPARATUS; O. P. Schuster, North Irwin, Pa. App. filed Aug. 12, 1922. Switch of the contactor type.

1,541,877. ELECTRICAL SWITCH; L. J. Voorhees, Binghamton, N. Y. App. filed May 27, 1921. Used in flashlight construction.

Financial and Corporate

Utility Stocks Improve

United Light "A" and Power Corporation Issues Rise Smartly—Trading Moderate

THE general market in power and light stocks nowadays is little more than marking time, a characterization that is equally applicable to the trading on the New York Stock Exchange, but in the week under review the gains outnumbered the losses. A temporary tightening of the rate for call money to 6 per cent, the highest since December, 1923; the failure of a large house and the earthquake had no great influence on the price trend. Several times alarm has been spread of dangers to the unlisted market in utilities in the event that money should tighten and loans should be called. However, the market meanwhile continues in sound position. So far evidence has been lacking even of the usual summer dullness that the market seasonally expects.

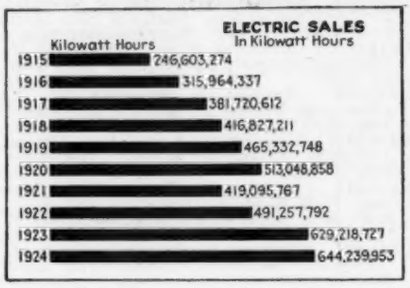
United Light & Power "A" stock featured trading in the unlisted market and on the New York Curb Market for the week under review. This stock went ex rights during the week and also added more than 13 points to its position of the week before. Since the new rights now are selling around 8 and the stock has risen to 112 the equivalent for old shares is about 120. While no definite announcement has been made it is understood that United Light & Power has added valuable properties to its group of late and that negotiations are under way for the acquisition of other valuable properties.

The spectacular advance in Power Corporation of New York, amounting to between 9 and 10 points for the week, may be attributed to the merger developments that are still under way. Southeastern Power & Light turned more active and added 3 points to its former position. Advances of approximately 2 points were scored by such issues as Adirondack Power & Light, American Light & Traction, American Superpower, Electric Bond & Share, Tampa Electric and others.

Commonwealth Power Issues Annual Report

Gross earnings totaling $31,527,709 were reported by the Commonwealth Power Corporation in the annual report for the year ended December 31, 1924, as compared with $30,120,764 for the previous year. The electric department was responsible for $20,217,613 of the total of $31,527,709, which figure represents 64 per cent. Approximately one-half of the electric total represents electricity used for lighting—residential, commercial and municipal. The other half, power, was well distributed among a wide variety of industries. A new high record was attained in the sales of electricity, the increase over the preceding year totaling 15,021,226 kilowatt-hours.

As disclosed in the annual report, the Commonwealth Power Corporation serves 441,750 electric and gas customers in 263 Michigan, Illinois, Indiana and Ohio communities. The acquisition of the properties of the Tennessee Electric Power Company, recently announced, and including electric power and light service to 68,000 customers



ELECTRIC SALES OF COMMONWEALTH POWER CORPORATION COVERING TEN-YEAR PERIOD

and 100 communities, will increase this figure.

Electric customers at the end of the year numbered 286,709 against 258,112 in 1923 and have grown to that amount from 97,214 in 1915. During 1924 the company inaugurated and carried out the most comprehensive construction and improvement program in its history—a total of $22,433,101 being expended. Of this amount 86 per cent was for the electric department and included part of the expenditures for the development of electric resources totaling 207,000 hp. Included in this total are the 61,300 hp. steam electric plant on the Illinois River at Peoria; the 54,000 hp. Saginaw River steam electric plant in Michigan; 35,000 hp. in Michigan hydro-electric developments, as well as additional installations in other stations.

Japanese Power Company Floats Another Issue.—The Great Consolidated Electric Power Company, Limited (Daido Denryoku Kabushiki Kaisha), issued another offering of first and general mortgage 6½ per cent sinking fund gold bonds priced at 86 and interest to yield over 7¾ per cent. The amount of the new issue was $13,500,000. The Great Consolidated is one of the two largest producers of electric power in Japan, selling its output for the most part under long-term contracts to retail light and power distributors, traction companies and large industrial consumers. A previous issue was placed by the company in the American market just about a year ago in the form of first mortgage bonds totaling $15,000,000. The company has called for payment certain 7 per cent gold bonds August 1 at par and interest.

Engineers' Public Service Company

Capital Set-Up of New Holding Company Organized by Stone & Webster

BY PAUL WILLARD GARRETT

NO BETTER illustration of the present-day tendency toward the formation of holding companies can be cited, perhaps, than the recent step taken by Stone & Webster, Inc., well-known utility engineers, in the creation of the Engineers' Public Service Company. It marks the first recognition of the holding company as an integral part of the management organization by these engineers. Stone & Webster, Inc., declare that the Engineers' Public Service Company of Delaware has been formed to "acquire public utility properties directly or through subsidiaries." While the former Gould properties, Virginia Railway & Power Company, are the first important group to be placed in the new Engineers' list, the announcement is made that "the policy of the company will be to acquire additional public utility properties when obtainable on advantageous terms, and pursuant to this policy several other properties are under consideration." However, the companies initially included furnish electric light and power, street railway or gas service in Richmond, Norfolk, Portsmouth, Suffolk, Petersburg, Hopewell, Fredericksburg and Ashland, Va., and Weldon and Roanoke Rapids, N. C., and surrounding territory.

The Engineers' Public Service Company is starting off with a simple capital structure. It has no funded debt. Upon completion of the present financing it will have 200,000 shares of $7 preferred stock and 500,000 shares of common. The preferred stock is being marketed at $100 a share, $50 a share being payable now and the remainder at a later date. With each share of preferred goes a bonus of half a share of common. Thus 100,000 shares of common will be distributed to purchasers of the 200,000 shares of preferred stock now marketed. Purchasers of 200,000 shares of common stock will, in connection with such purchase, receive option warrants for purchase of an additional 200,000 shares of common stock on or before January 2, 1928, at $25 a share; thereafter, on or before July 1, 1930, at $27.50 a share, and thereafter, on or before January 2, 1933, at $30 a share. In order to keep a proper margin of protection for the benefit of the preferred stockholders a provision has been inserted which stipulates that no preferred stock after the first 200,000 shares shall be issued unless the company shall have issued junior stocks in excess of 500,000 shares common stock to be presently issued for a consideration equal to 25 per cent of

the net amount to be received for the allotment certificates when paid in full.

The consolidated earnings of the Virginia Railway & Power Company and subsidiaries and the Spottsylvania Power Company, as compiled from official figures for the twelve months ended December 31, 1924, after deduction "of all prior charges and the proportion of earnings and depreciation applicable to minority interests" equal more than two and one-half times the annual dividend requirements on the 50 per cent paid allotment certificates now offered, and for the last three years have averaged more than twice requirements.

Several interesting provisions are inserted to protect the position of preferred stockholders. The $7 dividend preferred stock is of no par value, incidentally, and is preferred as to assets and cumulative dividends from July 1, 1925, over the common stock. In liquidation it is entitled to $100 a share and accrued dividends plus a premium of $10 a share if liquidation is voluntary. It is redeemable in whole or in part at the option of the company at $110 a share and accrued dividend.

Company Reports

The following statements of earnings were issued during the past week by electric light and power companies for the month of May.

Name of Company	Gross Earnings for May 1925	1924
Asheville Power & Light	$97,409	$84,658
Baton Rouge Electric	59,175	54,433
Blackstone Valley Gas & El.	392,651	366,370
Carolina Power & Light	262,907	191,158
Central Miss. Val. Elec. Prop.	47,536	45,591
Columbus Electric & Power	209,056	176,827
Eastern Shore Gas & Electric	64,396	46,886
Eastern Texas Electric	198,044	178,950
Edison Elec. Illg. of Brocton	128,744	124,391
El. Lt. & Pwr. of Abington & Rockland	38,021	31,923
El Paso Electric	212,351	194,878
Fort Worth Power & Light	223,419	251,465
Galveston-Houston Electric	342,139	334,493
Great Western Power	632,759	636,829
Houghton Co. Elec. Lt.	39,514	40,547
Idaho Power	261,247	253,493
Kansas City Pwr. & Light	789,180	754,664
Kansas Gas & Electric	502,968	455,348
Keokuk Electric	33,973	32,810
Key West Electric	20,925	18,747
Lowell Electric Light	118,025	113,921
Manchester Trac., Lt. & Pwr.	204,063	200,883
Mississippi River Power	276,080	282,076
Nebraska Power	328,111	306,398
New England Co. Pwr. Sys.	613,332	572,746
Northern Texas Electric	206,361	220,216
Pacific Power & Light	284,925	265,028
Paducah Electric	51,983	49,149
Penn Central L. & Pwr.	326,299	289,861
Puget Sound Power & Light	1,007,670	1,004,629
Savannah Electric & Power	151,533	151,315
Sierra Pacific Electric	95,687	92,787
Southern California Edison	2,092,128	1,909,017
Southern Canada Power	95,713	83,841
Tampa Electric	250,209	177,897
Texas Power & Light	494,840	498,089
Utah Power & Light	730,863	694,693
Yadkin River Power	166,742	134,291

New Capital Issues

During the past week the Toledo Traction, Light & Power Company floated an issue of five-year 5½ per cent secured gold notes amounting to $8,500,000, the price being 99 and interest, yielding 5.73 per cent. The company owns more than 97 per cent of the outstanding common stock of the Toledo Edison Company, $6,945,000 first mortgage 6 per cent bonds of the Community Traction Company and certain other securities, and upon completion of this financing will own all the outstanding securities (except directors' shares) of the Citizens Light & Power Company of Adrian, Mich.

In order to obtain funds to retire maturing obligations and for other corporate purposes the Western United Corporation also offered a short-term issue of collateral gold notes, series E, dated June 1, 1925, and maturing June 1, 1930, totaling $1,500,000. A third issue of short-term notes was made by the Central Indiana Power Company in the form of three-year 6 per cent collateral gold notes, series A, amounting to $5,000,000. Proceeds will be used for refunding purposes and to reimburse the company's treasury in part for betterments and extensions to properties.

Dividends Declared

The quarterly dividends listed below were announced during the past week by electric light and power companies and electrical manufacturing companies:

Name of Company	Per Cent	When Payable
Arkansas Light & Power, pf.	$1.75	July 1
Athens Railway & Electric, pf.	1¾	July 1
California-Oregon Power, pf.	1¾	July 30
Chickasha Gas & Electric, com.	1	June 30
Chickasha Gas & Electric, pf.	1¾	June 30
Cleveland Electric Illg., com.	2½	July 15
Cleveland Electric Illg., pf.	1¾	June 30
Edison Electric Illg. of Brocton	.62½	Aug. 1
Kentucky Utilities, pf.	1¾	July 15
Louisville Gas & Electric, pf.	1¾	July 15
Lowell Electric Light	.62½	Aug. 1
Milwaukee Elec. Ry. & Lt., 6% pf.	1	July 31
Missouri Gas & Electric, pr. lien	$1.75	July 15
Southern Wisconsin Electric, pf.	1¾	July 15
United Light & Rys., pr. pf.	$1.62½	Aug. 1
Wisconsin River Power, pf.	$1.75	Aug. 20
Allis-Chalmers Mfg., com.	1¾	Aug. 15
Hurley Machine	$1	July 17
Superheater Co.	$1.50	July 15

Stockholders' Rights.—The stockholders of the Public Service Company of Northern Illinois of record July 3 have been given the right to subscribe on or before August 1 for new or additional shares of common stock. (without par value) at $100 per share in the ratio of one new share of common stock for each five shares of stock of all classes held.

Customer-Ownership Campaign Is Closed.—Final figures in the customer-ownership campaign which, inaugurated May 1 by the Public Service Corporation of New Jersey, was brought to a close on June 30, show that $6,516,800 in 7 per cent cumulative preferred stock was sold to 10,972 subscribers.

Electric Power & Light Increases Directorate.—The number of directors of the Electric Power & Light Corporation has been increased from five to fifteen by the election of H. C. Abell, president National Power & Light Company; Irving W. Bonbright, chairman of the board Bonbright & Company, Inc.; Anson W. Burchard, vice-chairman of the board General Electric Company; Charles Martin Clark, treasurer of Bradstreet's; Rollin P. Grant, vice-chairman of the board Irving Bank-Columbia Trust Company; C. E. Groesbeck, president American Power & Light Company; Charles Hayden of Hayden, Stone & Company; William C. Potter, president Guaranty Trust Company; Frederick Strauss, J. & W. Seligman & Company, and H. A. Tilney, president Bankers Trust Company.

Indiana Utility Reclassifies Stock.—The Southern Indiana Gas & Electric Company of Evansville, Ind., has reclassified its common stock from $5,000,000 to 500,000 shares of no par value. The company also has increased its preferred stock from $5,000,000 to $10,000,000.

Baltimore Listing.—The board of governors of the Baltimore Stock Exchange has approved the listing of the recently issued $1,000,000, Series D, 6 per cent cumulative preferred stock of the Consolidated Gas, Electric Light & Power Company. The new $9,000,000 issue of first refunding mortgage sinking fund 5 per cent gold bonds, Series F, was also added to the list.

To Convert Bonds Into Stock.—The Clarion River Power Company on July 1 converted its 8 per cent cumulative income gold bonds, due in 1932, into its class A 8 per cent preferred stock at the rate of $100 of stock for each $100 of bonds. As an alternative the Pennsylvania Electric Corporation has offered to exchange for these outstanding Clarion River bonds its 7 per cent cumulative preferred stock at the rate of one share of Pennsylvania Electric, par $100, and one-tenth of a share of Pennsylvania Electric common (no par value) for each $100 of Clarion River bonds presented for exchange on or before June 25.

Bonds Called in July.—Among the securities of electric light and power companies called for payment in advance of maturity are the following:

Name of Company	Due	Amount
Clarion River Power, 8s.	1932	$2,649,000
Galveston-Houston Electric, 7s.	1925	1,700,000
Southwestern Utilities, 7s.	1926	1,700,000
Iowa Electric, 1st 6s.	1934	1,677,000
National Gas, El. Lt. & Pw. A 6s.	1931	1,295,000
National Gas, El. Lt. & Pw., B 6s.	1931	1,239,300
General Gas & Electric, ev. 5s.	1932	840,000
National Lt. Ht. & Pwr., B 7s.	1928	434,000
Intermountain Ry., Lt. & Pwr., 6s.	1937	422,700
Otter Tail Power, 7s.	1950	406,400
Texas Public Service, 6s.	1933	348,000
Fayetteville Gas & Electric, 6s.	1928	137,000
Columbia Gas & Electric, 5s.	1927	*105,000
Union Electric Lt. & Pwr., 5½s.	1954	*52,000
Union Electric Lt. & Pwr., 6s.	1944	*50,000

* Not entire issues.

"Bare Bones Value" as Used by Utility Bankers.—Testifying before the Massachusetts Department of Public Utilities recently in the New England Telephone & Telegraph Company's rate case, John R. Macomber, president Harris, Forbes & Company, Boston, stated that before reaching a decision as to taking part in marketing a bond issue for a public utility this house makes an investigation of the property from the local business and public relations standpoints. An engineering analysis is prepared of the status of the plant, and legal questions relating to franchises, leases, titles, etc., are looked into. Then the house sets a so-called "bare-bones" value upon the property, estimating the present depreciated value, the historical cost versus present-day costs and the pre-war cost and throwing out good will, undeveloped water powers and other intangibles. This low value is regarded as essential in planning for loans and is a convenient base upon which to figure from the bankers' angle.

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stocks is $100.)

Companies	Bid Price Friday, July 3	Low 1925	High 1925
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	101	98	106
Appalachian Power, 7 per cent	98	92	100
Arkansas Light & Power 7 per cent	96½	92	102
Asheville Power & Light 7 per cent	a101	101	102
Central Illinois Public Service 6 per cent	85	84	93
Colorado Power 7 per cent	94	93	98
Connecticut Light & Power 7 per cent	106	105	110
Consumers' Power 6 per cent	94¼	90	97
Dayton Power & Light 6 per cent	95	88	100
Duquesne Light 7 per cent	a110½	105	111½
Eastern Texas Electric 6 per cent	100	100	105
Empire District Electric 6 per cent	78	78	85
Fort Worth Power & Light 7 per cent	a101½	101½	103
Great Western Power 7 per cent	102	...	...
Illinois Northern Utilities 6 per cent	88	82	92
Illinois Power & Light 7 per cent	95½	92½	98
Kansas Gas & Electric 7 per cent	a101½	101½	102½
Long Island Lighting 7 per cent	101	100	105
Minnesota Power & Light 7 per cent	a100	100	101
Mississippi River Power 6 per cent	92	87½	94
Nebraska Power 7 per cent	a102½	101	103
Niagara Falls Power 7 per cent—25	27¼	28	29
Niagara, Lockport & Ont. Power 7 per cent	109	101½	110
Northern States Power 7 per cent	96	95	100
Ohio Public Service 7 per cent	98	97	100
Pacific Gas & Elec 6 per cent	97	92	98
Pacific Power & Light 7 per cent	a101	101	103
‡Penn. Central Light & Power	68	60	68
Penn-Ohio Power & Light 7 per cent	97	91	100
Pennsylvania Power & Light $7—no par	a103½	103	104½
Penn. Public Service 7 per cent	90	90	100
‡Philadelphia Electric 8 per cent—25	39	37¼	45
Southern California Edison 8 per cent	125	115	128
Southern California Edison 7 per cent	107	105	107½
Southern California Edison 6 per cent	93½	90	95
Tennessee Electric Power, 6 per cent	85	80	85
Texas Power & Light 7 per cent	a102	102	104
Utah Power & Light 7 per cent	a100½	100½	101½
Western States Gas & Electric 7 per cent	89	82	92
Yadkin River Power, 7 per cent	a102	101	103
Holding Companies			
American Gas & Electric 6 per cent—no par	90	85	91
American Light & Traction 6%—no par	100¼	93	101½
American Power & Light 6 per cent	90½	84	91¼
American Public Service 7 per cent	90	88	94
American Public Utilities 7 per cent	89	87	95
American Water Works & Electric 7 per cent	a 99½	99	103
Associated Gas & Electric 7 per cent—1 per cent extra—50	a 50	...	...
Associated Gas & Electric—$6—no par	84	...	...
Carolina Power & Light $7—no par	105½	100	107
Central Indiana Power 7 per cent	89	88	95
Cities Service 6 per cent	82	80	83
Commonwealth Power 6 per cent	83	80	85½
Continental Gas & Electric 7 per cent pr.pf.	92½	89	95
Electric Bond & Share 6 per cent	a105½	104½	107
General Gas & Electric—$8—no par	143	104½	155
*Middle West Utilities 7 per cent	97	91½	98¾
National Power & Light—$7—no par	101½	95	99
North American 6 per cent—50	a 49¾	46¾	50½
Public Service Corp. of N. J. 7 per cent	90½	99	102½
Public Service Corp. of N. J. 8 per cent	a113	109	114¾
Standard Gas & Electric—8%—50	a 53½	50½	54½
United Light & Power—$6.50—no par	90	83	99
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	81½	31	93
Appalachian Power—no par	78	70	83
Arkansas Light & Power	100	65	101
Brooklyn Edison	134½	120¾	140¾
Buffalo General Electric—no par (new)	66	44	69
*Commonwealth Edison	139	130½	141¾
§Consolidated Gas, Electric Light & Power	44	32	44¼
Dayton Power & Light	420	180	460
Detroit Edison	a124½	110	125¾
‖Edison Electric Illuminating of Boston	212½	200	213
Long Island Lighting (new)	100	60	105
Mississippi River Power	58	37	62
Montana Power	a 83½	64	87¼
Niagara Falls Power—no par	70	45¼	70
Niagara, Lockport & Ontario Power—no par	65	60	73
Northern Ohio Power	10	5	13½
Northern States Power	116	103	123
North Texas Electric	40	40	70
Pacific Gas & Electric	a113½	102½	118¾
§Pennsylvania Water & Power	150	126½	152½
‡Philadelphia Electric—25	39½	37¼	47¾
Public Service Co. of Northern Illinois	122	97	124
Puget Sound Power & Light	54	49	61
Southern California Edison	119	102	121
Tennessee Electric Power—no par	66	47	69
Virginia Power	66	65	92
Virginia Railway & Power	a120½	64¼	123
West Penn. Co.	a122	105	145
Holding Companies			
American Gas & Electric—no par	77½	70	85
American Light & Traction	168	139	173½
American Power & Light	61½	52	67
American Public Utilities	78	70	85
American Water Works & Electric	a 62	34¾	68
Associated Gas & Electric, Class A	a 32½	...	...
Carolina Power & Light	390	290	425
Cities Service (new)	38½	34	43
Columbia Gas & Electric—no par	a 64	45¾	69¾
Commonwealth Power Corp.—no par	161	106	168
Consolidated Gas—no par	a 87¼	74¼	89½
Continental Gas & Electric	95	77	99
Electric Bond & Share Securities	a 70½	68	71½
Electric Power & Light	a 37½	17¾	37½
Federal Light and Traction	a 33¾	30	36
General Gas & Electric	170	72	183
Lehigh Power Securities—no par	145	82	131
*Middle West Utilities—no par	93½	82½	102¾
National Power & Light—no par	335	185	357
North American—10	a 49¾	41½	50¾
Philadelphia Co.—50	a 58½	51½	61¾
Power Securities—no par	17	...	...
Public Service Corp. of N. J.—no par	a 70¾	62½	74
Standard Gas & Electric—no par	a 52	40¼	54¾
United Gas & Electric (Conn.)—no par	45	26	49

BONDS

Operating Companies					
Adirondack Power & Light	6s	1950	105½	102½	105½
Alabama Power	5s	1946	99½	96	100
Appalachian Power	5s	1941	98½	96	99½
Brooklyn Edison	5s	1949	102	99½	103
	6s	1930	105½	104	105½
Cleveland Electric Illuminating	5s	1939	102	100	102
Commonwealth Edison	5s	1943	102½	99½	102
	5s	1953	100½	98½	101
§Consol. Gas, Elec. Lt. & Pwr.	4½s	1935	97½	93½	97½
	6s	1949	106½	104½	107½
Consumers' Power	5s	1936	100½	99	100½
	5s	1952	97½	90½	100
Detroit Edison	5s	1933	101	99½	102½
Duquesne Light	6s	1949	106	104½	107½
Great Western Power	5s	1946	98	95	99
Kansas City Power & Light	5s	1952	100½	95½	101
Mississippi River Power	5s	1951	99½	96½	100
Montana Power	5s	1943	100½	97½	100½
New England Power	5s	1951	102½	100¼	103
New York Edison	6½s	1941	114¼	112	115½
Niagara Falls Power	6s	1932	106	103½	106½
Northern States Power	5s	1941	98½	93	99½
	6s	1941	105½	103	107½
Ohio Power	7s	1951	106½	106½	107½
Pacific Gas & Electric	5s	1942	97½	93½	99
Pennsylvania Water & Power	5s	1940	101	99½	102
‡Philadelphia Electric	5s	1966	103½	100½	103½
	5½s	1953	106½	104½	107½
	6s	1941	107½	106	108½
Portland Electric Power	6s	1947	100	96½	100
Southern California Edison	5s	1939	100	99½	101
	6s	1944	104¾	102½	105½
Tennessee Electric Power	6s	1947	103	99½	104½
Texas Power & Light	5s	1937	98½	97	99½
Toledo Edison	7s	1941	109½	108½	110
Utah Power & Light	5s	1944	96½	91	98½
Holding Companies					
Alabama Traction, Light & Power	5s	1962	92½	86	95
American Gas & Electric	6s	2014	98	96½	98½
American Power & Light	6s	2016	97	94	98
Amer. Water Works & Electric	5s	1934	95¾	92½	98
Associated Gas & Electric	6½s	1954	a102½	...	...
Central Indiana Power	6s	1947	98½	95½	98½
Commonwealth Power	6s	1947	103	97½	103½
Consolidated Cities Lt., Pwr. & Tr.	5s	1962	80½	75½	82½
Illinois Power & Light	6s	1953	102	100½	102½
United Light & Railways	5s	1932	96	93½	97½
	6s	1952	99½	95½	100½

ELECTRICAL MANUFACTURING COMPANIES

PREFERRED STOCKS

Allis-Chalmers Manufacturing	a105	103½	108
Worthington Pump & Machinery A	74	79	88

COMMON STOCKS

Allis-Chalmers Manufacturing	a 83¾	71½	86½
American Bosch Magneto—no par	a 35½	26½	54½
Electric Storage Battery—no par	a 64½	60½	70½
General Electric	a287½	227¼	320
General Electric—10	a 11½	11	11¾
*Hurley Machine—no par	46½	41¾	56
†Wagner Electric	37	26½	50
Westinghouse Electric & Manufacturing—50	a 71¾	66¼	84
Worthington Pump & Machinery	a 41½	36¼	79¾

BONDS

General Electric	3½s	1942	84½	83	85
	5s	1952	106½	101½	107
Robbins & Myers	7s	1952	70	63½	73½
Western Electric	5s	1944	100½	98	101
Westinghouse Electric & Mfg.	7s	1931	107	106¼	108½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. ‖Boston Stock Exchange. §Baltimore Stock Exchange.
a Bid price, low and high, Tuesday, July 7.